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CONNECTICUT RIVER BASIN BLOOMFIELD, CONNECTICUT

# BLUE HILLS DAM CT 00496

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

MAY 1981

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### 16. SUPPLEMENTARY NOTES

Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

DAMS, INSPECTION, DAM SAFETY,

Connecticut River Basin Bloomfield, Connecticut

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Blue Hills Dam consists of an earth embankment, 4.045 ft. long with a top width of 12 ft. and a maximum height of 24.5 ft. Based on visual inspection and review of available plans and reports, Blue Hills Dam is judged to be in good condition. As per the Corps of Engineers' Recommended Guidelines for Safety Inspection of Dams, the Blue Hills Dam is classified as 'Intermediate' in size qith 'High' hazard potential. A test flood equal to the PMF was selected in accordance with the Corps of Engineers.



### DEPARTMENT OF THE ARMY

NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254

REPLY TO ATTENTION OF:

NEDED

JUN 3 0 1981

Honorable William A. O'Neill Governor of the State of Connecticut State Capitol Hartford, Connecticut 06115

Dear Governor O'Neill:

Inclosed is a copy of the Cold Spring Reservoir Dam (CT-00495) Phase I Inspection Report, prepared under the National Program for Inspection of Non-Federal Dams. This report is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. I approve the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is vitally important part.

Copies of this report have been forwarded to the Department of Environmental Protection, and to the owner, State of Connecticut, Department of Environmental Protection. Copies will be available to the public in thirty days.

I wish to thank you and the Department of Environmental Protection for your cooperation in this program.

Sincerely,

Incl As stated C. E. EDGAR, III Colonel, Corps of Enginee

Colonel, Corps of Engineers Commander and Division Engineer



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BLUE HILLS DAM
CT 00496

CONNECTICUT RIVER BASIN BLOOMFIELD, CONNECTICUT

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

AND THE RESERVE OF THE STATE OF

# NATIONAL DAM INSPECTION PROGRAM PHASE I INSPECTION REPORT

IDENTIFIC	CATION NO:	CT-00496		
NAME OF I	DAM:	Blue Hills Dam		
TOWN:		Bloomfield		
COUNTY AI	ND STATE:	Hartford County, Connecticut		
STREAM:_I	Easterly branch	of Beamans Brook, a tributary of		
_1	North Branch of	Park River		
DATE OF :	INSPECTION:	December 15, 1980		

### BRIEF ASSESSMENT

Blue Hills Dam consists of an earth embankment, 4,045 ft. long with a top width of 12 ft. and a maximum height of 24.5 ft. In addition, there is a 1,450 ft. long dike running parallel to Blue Hills Avenue, which is 10 ft. wide at the top and has a maximum height of 6 ft.

The two outlets for the dam are the unregulated principal spillway and emergency spillway. The principal spillway is a drop inlet structure consisting of a two stage reinforced concrete intake riser discharging through a 30" diameter, 153 ft. long reinforced concrete pipe under the dam embankment. The emergency spillway is a trapezoidal grassed channel, 210 ft. wide at the control section with its crest 6.1 ft. below the top of the dam.

Based on visual inspection and review of available plans and reports, Blue Hills Dam is judged to be in good condition. Some features found existing that could affect the stability of the dam are standing water at the seepage drain outlet nearest the emergency spillway and wheel ruts and minor erosion gullies on the crest and slopes.

The dam is a flood control project and, therefore, the reservoir is dry except during periods of heavy rainfall. With the reservoir dry, the inspection could not reveal seepage conditions. It is recommended that the owner employ a qualified registered engineer to do the following within two years of receipt of this report:

Inspect the dam during the time that water is impounded in the reservoir with particular attention to locating any possible seepage;

Determine the origin and significance of the standing water at the seepage drain outlet nearest the emergency spillway;

Design a permanent surface on the dike embankment at the unility service road crossing capable of carrying traffic without rutting or eroding.

It is recommended that the owner repair the wheel ruts and minor erosion gullies on the crest and slopes of the dam and dike embankments within two years of receipt of this report. Other remedial measures contained in Section 7 should also be carried out within a period of two years.

As per the Corps of Engineers' Recommended Guidelines for Safety Inspection of Dams, the Blue Hills Dam is classified as 'Intermediate' in size with 'High' hazard potential. A test flood equal to the probable maximum flood (PMF) was selected in accordance with the Corps of Engineers' Guidelines. The calculated test flood inflow of 1,800 cfs results in a routed outflow of 1,570 cfs. The maximum spillway capacity is 9,400 cfs at the top of the dam. The spillway is capable of passing 600% of the

routed test flood outflow without overtopping the dam. The storage capacity to the top of the dam is 2,200 ac-ft. and up to the test flood elevation, 1,050 ac-ft.

As the dam is a 'high' hazard potential and a potential breach may result in excessive economic loss and more than a few lives may be endangered, an emergency operation plan should be prepared and implemented if and when necessary. An operation and maintenance manual to take care of normal routine procedures should also be prepared.

GOODKIND & O'DEA, INC.
AND
SINGHAL ASSOCIATES
(J.V.)

Ramesh P. Singhal, Ph.D., P.E. (Singhal Associates)

Lawrence J. Buckley, P.E. (Goodkind & O'Dea, Inc.)



This Phase I Inspection Report on Blue Hills Dam (CT-00496) has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgement and practice, and is hereby submitted for approval.

CARNEY M. TERZIAN, MEMBER

Design Branch

Engineering Division

JOSEPH W. FINEGAN, JR., MEMBER

Water Control Branch Engineering Division

Chemista Tolkinan

ARAMAST MAHTESIAN, CHAIRMAN Geotechnical Engineering Branch Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR

Chief, Engineering Division

# PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

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It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I Inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

The Phase I Investigation does <u>not</u> include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety of the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

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OVERVIEW PHOTO TAKEN DECEMBER 20, 1980

Goodking & O'dea Inc.—U.S. Army Engineer Civ. New England Singhal associates Livi. Corps of Engineers Engineers Waltham, Mass. NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

OVERVIEW PHOTO OF DAM

BLUE HILLS DAM BLOOMFIELD, CONNECTICUT

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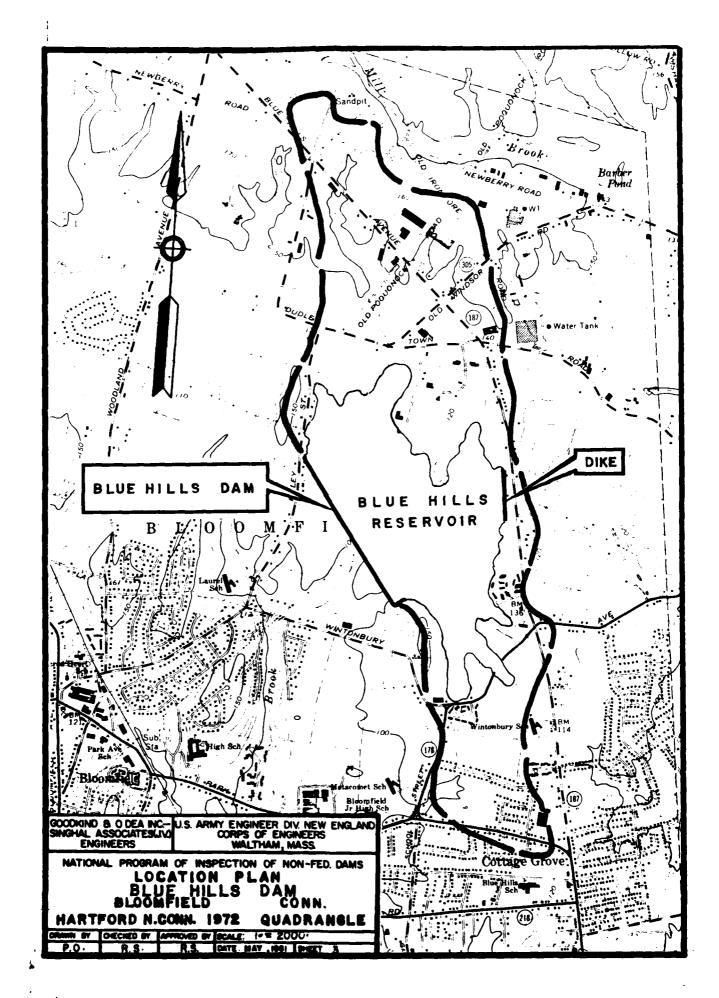
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OVERVIEW PHOTO OF DIKE

BLUE HILLS DAM BLOOMFIELD, CONNECTICUT

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# NATIONAL DAM INSPECTION PROGRAM PHASE I INSPECTION REPORT

# PROJECT INFORMATION Section 1

### 1.1 General

### a. Authority

Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Goodkind of O'Dea, Inc., Hamden, Conn. and Singhal Associates, Orange, Conn. (Joint Venture) have been retained by the New England Division to inspect and report on selected dams in the State of Connecticut. Authorization and notice to proceed were issued to Goodkind of O'Dea, Inc. and Singhal Associates (J.V.) under a letter of December 9, 1980 from Colonel William E. Hodgson, Jr., Corps of Engineers. Contract No. DACW 33-81-C-0022 dated December 9, 1980 has been assigned by the Corps of Engineers for this work.

# b. Purpose of Inspection

The purposes of the program are to:

- Perform technical inspection and evaluation of nonfederal dams to identify conditions requiring correction in a timely manner by non-federal interest.
- Encourage and prepare the States to quickly initiate effective dam inspection programs for non-federal dams.

5. To update, verify and complete the National Inventory of Dams.

# 1.2 Description of Project

### a. Location

Blue Hills Dam is situated on the easterly branch of Beamans Brook which flows into the North Branch of the Park River, approximately 2.3 miles downstream from the dam. The location is approximately 1.3 miles northeast of the Bloomfield Town Hall and 0.8 miles northwest of the intersection of Wintonbury and Blue Hills Avenues. The geographic location of this site may be found on the Hartford North Quadrangle Map, with coordinates of latitude N41° 50.3' and longitude W72° 42.8'.

# b. Description of Dam and Appurtenant Structures

The Blue Hills Reservoir is impounded by a dam and a dike. The dam consists of a grass covered earth embankment approximately 4,045 ft. long with a top width of 12 ft. and upstream and downstream slopes of 3 horizontal to 1 vertical. The top of the dam is at an elevation of 116.1' Metropolitan District Commission Datum (MDC Datum) (2.08 ft. higher than NGVD) with a maximum height of 24.5 ft. A cutoff trench 10 ft. wide and approximately 3 ft. deep is located under the upstream slope. Underlying the downstream dam embankment, there is a 2 ft. thick gravel drainage blanket with a 6" perforated pipe underdrain system. The drainage blanket extends to the toe of the downstream slope under most of the length of the dam.

The dike running parallel to Blue Hills Avenue is a low grass covered earth embankment, 1,450 ft. long, with a top width of 10 ft. and slopes of 3 horizontal to 1 vertical.

The top of the dike is at elevation of 116.1' (MDC Datum) with a maximum height of 6 ft. A 10 ft. wide, 3 ft. deep cutoff trench is centered under the crest of the dike embankment. An 18" BCCM inlet pipe is located near the middle of the dike's Accumulated stormwater runoff between the dike and Blue Hills Avenue passes through the pipe which is under the dike embankment into the reservoir area. A top-hinged iron flap gate located at the downstream end of the inlet pipe prevents any impounded stormwater in the reservoir from flowing out. The principal spillway is a drop inlet structure consisting of a two stage reinforced concrete intake riser discharging through a 30" reinforced concrete pipe which runs under the dam embankment. The pipe is 153 ft. long and discharges into the downstream channel which is rip-rapped for a distance of 37 ft. beyond the outlet. The low level inlet of the intake riser is at an invert elevation of 94.0' (MDC Datum) whereas the high level weir inlets are at an elevation of 100.0' (MDC Datum). The intake riser has trash racks at both the low level inlet and the high level weir inlets.

The emergency spillway at the dam is a 210 ft. wide grass trapezoidal channel. At the control section of the spillway the crest elevation is 110.0'(MDC Datum), which is 6.1 ft. below the crest elevation of the dam.

## c. Size Classification - 'Intermediate'

According to the Corps of Engineers' Recommended

Guidelines for Safety Inspection of Dams, a dam is classified

'Intermediate' if either the height lies between 40' and 100'

or the storage is between 1,000 ac-ft. and 50,000 ac-ft. The Blue Hills Dam has a maximum height of only 24.5', but the maximum storage to the top of the dam is 2,200 ac-ft. As such, it is classified as 'Intermediate' in size.

### d. Hazard Classification - 'High.'

Based on the Corps of Engineers' Recommended Guidelines for Safety Inspection of Dams, the hazard classification for the dam is 'high'. A dam failure analysis indicates that a breach of the Blue Hills Dam would result in an instantaneous downstream flood flow of 243,000 cfs causing a 16' high wave of water to travel down in the brook and along its overbanks on both sides. Continuation of the valley flood routing indicates that even as far down as 3,500' from the dam, the excess flow and the wave height are as high as 63,000 cfs and 16' above the bottom of the brook.

The depths of flow in the brook in the vicinity of 47 down-stream houses considered (the last one being 3,500 ft. from the dam), range as below:

	Pre-Failure 	Post-Failure Depth
First 10 houses:	4.5 ft.	16.0 ft.
Next 21 houses:	4.5 ft.	17.0 ft.
Next 16 houses:	5.0 ft.	16.5 ft.

None of these houses are subject to potential flooding under test flow conditions. In case of dam failure, they will be flooded to depths ranging up to 4 ft. above their first floor elevation.

The dam failure would flood a large number of houses, roads

1

and public buildings and could result in the loss of more than a few lives, and excessive economic loss on the downstream side.

### e. Ownership

The Blue Hills Dam is owned by:

The State of Connecticut
Department of Environmental Protection
State Office Building
165 Capitol Avenue
Hartford, Connecticut 06115
Telephone: (203) 566-7244/7245.

# f. Operator

Mr. Victor Galgowski Superintendent, Dam Maintenance DEP (Water Resources Unit) 165 Capitol Avenue Hartford, Connecticut 06115 Telephone: (203) 566-7245

# g. Purpose of Dam

The purpose of the dam is for flood control.

### h. Design and Construction History

The dam and appurtenant structures were designed in the year 1960 by Anderson-Nichols, Consulting Engineers, Boston/Hartford, under the direction of the U.S. Department of Agriculture, Soil Conservation Service. The construction was completed in 1964. Design report and construction plans are available at the Soil Conservation Service Office in Storrs, Connecticut.

## i. Normal Operational Procedures

Blue Hills Dam is a dry dam. The normal operation and maintenance is limited to cutting the grass and brush from the slopes of the dam and dike embankments and cleaning the trash racks at the principal spillway intake riser.

### 1.3 Pertinent Data

# a. Drainage Area

The drainage area consists of 1.90 square miles of flat terrain with an average slope under 1%. Elevations in the basin range from about 100 ft. to 170 ft. MSL. Most of the area is open and inhabited with several town roads and the State Route 187 passing through it.

## b. Discharge at Damsite

Two separate discharge spillway facilities exist at the damsite. The principal spillway under the dam consists of a two stage reinforced concrete intake riser and a 153 ft. long 30" reinforced concrete pipe. The emergency spillway is a grassed trapezoidal channel 210 ft. wide at the control section, and located at the south end of the dam.

1.	Outlet works (conduits)	1-30" RCP
	Low level inlet invert elevation: High level weir inlet elevation: Discharge capacity at test flood: Elevation:	94.0 100.0 90.0 cfs 111.8
2.	Maximum known flood at damsite:	Unknown
3.	Ungated spillway capacity at top of dam: Elevation:	9,400 cfs 116.1
4.	Ungated spillway capacity at test flood elevation of lll.8:	1,570 cfs
5.	Gated spillway capacity at normal pool elevation of:	N/A
6.	Gated spillway capacity at test flood elevation:	N/A
7.	Total spillway capacity at test flood elevation of 111.8:	1,570 cfs

	8.	Total project discharge at top of dam: Elevation:	9,400 cfs 116.1
	9.	Total project discharge at test flood: Elevation:	1,570 cfs 111.8
c.	Elev	ation - Feet above MDC Datum. (2.08' than NGVD)	higher
	1.	Stream bed at toe of dam:	91.6 (downstream channel)
	2.	Bottom of cutoff:	93.0 (varies)
	3.	Maximum tailwater:	N/A
	4.	Normal pool:	N/A
	5.	Full flood control pool:	110.0
	6.	Spillway crest: Emergency Principal (High level weir	110.0
		inlet)	100.0
	7.	Design surcharge (original design)	112.4 (design highwater)
	8.	Top of dam	116.1
	9.	Test flood surcharge:	111.8
đ.	Rese	rvoir - Length in feet	
	1.	Normal pool:	N/A
	2.	Flood control pool:	5,800 ft.
	3.	Spillway crest pool: Emergency spillway Principal spillway (High level weir inlet)	5,800 ft. 1,400 ft.
	4.	Top of dam:	8,200 ft.
	5.	Test flood pool:	7,200 ft.

#### е. Storage - Acre-Feet

1. Normal pool: N/A

700 ac-ft. 2. Flood control pool:

3. Spillway crest pool: 700 ac-ft. Emergency spillway Principal spillway (high 25 ac-ft. level weir inlet)

2,200 ac-ft. 4. Top of dam:

Test flood pool: 5. 1,050 ac-ft.

#### f. Reservoir surface - Acres

1. Normal pool: N/A

2. Flood control pool: 175 acres

Spillway crest pool: Emergency spillway 175 acres Principal spillway (high level weir inlet) 5 acres

4. Top of dam: 365 acres

5. Test flood pool: 220 acres

#### Dam g.

		•	
		Dam	Dike
1.	Type:	Earth Embankment	Earth embankment
2.	Length:	4,045 ft.	1,450 ft.
3.	Height:	24.5 ft.	6.0 ft.
4.	Top width:	12.0 ft.	10.0 ft.
5.	Side slopes:	3 Hor. to 1 Ver. for both U/S and D/S slopes	Same as dam
6.	Zoning	Zone A: U/S shell: compacted imper- vious fill. Zone B: Core and	Zone A: U/S shell and core: Compacted impervious fill. Zone B: Core and D/S

plastic sandy silt or silty fine sands)

D/S shell: com- shell pacted fill (non- fill.

shell: compacted

D/S shell: com-

1-8

			Dam	Dike
	7.	Impervious core:	N/A	Compacted impervious fill
	8.	Cutoff:	10 ft. wide, 3 ft. deep cutoff trench.	10 ft. wide, 3 ft. deep cutoff trench
	9.	Grout curtain:	N/A	N/A
	10.	Other	2' thick drainage blanket and 6" per- forated pipe under- drain system	
h.	Div	ersion and Regula	ating Tunnel	N/A
i.	Spi	llway	Principal Spillway	Emergency Spillway
	1.	Type:	Drop inlet structure consisting of a two stage reinforced concrete intake riser w/30" reinforced concrete pipe	
	2.	Length of crest:	15 ft. (high level inlet weirs)	210 ft. (at control section)
	3.	(MDC Datum) w/flashboards:	N/A 100.0 (high level weir inlets)	N/A 110.0
	4.	Gates	N/A	N/A
	5.	Upstream channel	Natural channel & relocated brook	N/A
	6.	Downstream channel	Excavated channel w/ 37 ft. length rip-rapped at outlet	N/A
	7.	General	N/A	N/A

j. Regulating Outlets:

The only outlet is the unregulated principal spillway. (See Section 1-3-i, page 1-9)

- k. Inlet Pipe
  - 1. Type:

18" BCCM inlet pipe with top-hinged flap gate on the outlet end. Located under dike embankment.

2. Invert (MDC Datum)
 upstream:
 downstream:

110.0

3. Size:

18" BCCM Pipe

4. Control Mechanism:

Iron flap gate hinged to the top of the outlet end of the pipe.

# ENGINEERING DATA Section 2

# 2.1 Design Data

A comprehensive design report prepared in 1960 and entitled "North Branch Park River Watershed Protection Project, Design Report, Site No. 2, Bloomfield, CT." is available. The design report includes hydrologic and hydraulic data and computations soil borings, soil laboratory test data, dam stability analysis and seepage analysis.

## 2.2 Construction Data

"As-Built" drawings entitled "North Branch Park River Water-shed Protection Project, Floodwater Retarding Structure, Site No.

2, Blue Hills Dam" are available. These drawings have been reviewed and found to show good agreement with the visual inspection.

Certain details have been copied from the "As-Built" drawings provided by the U.S. Department of Agriculture, Soil Conservation Service in Storrs, Connecticut and are included in Appendix B.

### 2.3 Operational Data

Normally a pool does not exist and water level readings are not taken at any specified intervals. According to the owner, water levels have never risen to the level of the emergency spillway crest. No formal operation records are known to exist.

# 2.4 Evaluation of Data

# a. Availability

Available existing data was provided by the State of Connecticut Department of Environmental Protection who are the

owners and the U.S. Soil Conservation Service who designed and constructed the dam. Location of the available data is given in Appendix B.

# b. Adequacy

The engineering data available, when coupled with visual inspection, was generally adequate to perform an assessment of the dam.

# c. Validity

A comparison of record data and visual observation reveals no significant discrepancies in the record data.

# VISUAL INSPECTION Section 3

## 3.1 Findings

# a. General

The formal field inspection took place December 15, 1980 by engineers from Goodkind & O'Dea, Inc., and Singhal Associates. Detailed checklists, which are included in Appendix A, were utilized for the inspection of the dam, dike and spillways. During the visual inspection, photographs showing the dam features and problem areas were also taken. These photographs, along with the photo location plans, are given in Appendix C.

The general condition of the project was good as assessed by the visual inspection; however, the inspection did reveal some areas requiring maintenance work and/or monitoring or needing further study.

The reservoir area was dry at the time of the inspection.

# b. Dam.

The dam is a grass-covered, earthfill embankment with a gravel drainage blanket underlying the downstream slope. The dam alignment was good with no sign of vertical or horizontal movement as shown in Photos 1, 2 and 3. Some moderate vehicular rutting was observed along the crest of the dam embankment, which was covered by a well developed, stable growth of grass (See Photos 2 & 3). Minor erosion associated with the rutting along

the dam crest was observed on the embankment slopes as noted on the general dam plan in Appendix B. There was also evidence of some moderate vehicular trespassing along the downstream slope and toe of the dam embankment as shown by the wheel tracks in Photo 2.

Standing water was observed in the vicinity of the seepage drain outlet nearest the emergency spillway as shown on the general dam plan in Appendix B. The ground in the area of the standing water was soft, with some cattail growth, indicating that this wet condition may be year-round (See Photo 4). The outlet of the pipe was covered with earth and/or water and could not be located and, therefore, was not inspected.

The two seepage drain outlets at the principal spillway contained between 2 and 3 inches of moist silt, whereas the other outlet at the north end of the dam was clean and dry. Minor brush growth was noted along the slopes of the ditch running along the downstream embankment toe.

# c. Appurtenant Structures

### Principal Spillway

The normal flow of the brook and the impounded stormwater runoff is carried through the dam embankment by the principal spillway which primarily consists of a two stage concrete intake riser and a 30" reinforced concrete pipe (Photo 6 & 7). The concrete of the intake riser was in good condition with no visible cracking or spalling. Some minor accumulation of debris was observed in front of the trash rack which was missing one bar (Photo 6). The channel and side ditch, upstream of the intake

structure, were clean with minor brush growth along the side slopes (See Photo 5).

The reinforced concrete discharge pipe was clean with some minor exterior concrete spalling at the outlet end (Photo 7). Under the concrete cradle which supports the pipe, a small scour pocket, approximately 6 inches deep was noted. The riprapped area downstream of the outlet appeared stable with no sign of failure.

# Emergency Spillway

The grass-lined spillway just south of the dam embankment was generally in good condition (See Photo 1). Minor rutting
caused by vehicular trespassing was observed along the south cut
slope of the spillway and on the floor of the discharge channel
as slown in Photo 9. The three drainage ditches located along
the floor of the approach channel were stable with no detrimental
erosion.

### Dike

The grass-covered earthfill dike embankment was generally in good condition with good alignment and stable slopes. Where the utility service road crossed the dike, a depressed area lacking vegetative cover was observed as noted on the general dike plan in Appendix B. Tire ruts were observed along the entire crest of the dike with heavy rutting at the north end. Moderate brush growth along the slopes at the north end of the dike was also noted as shown in Photo 10. There was no evidence of any downstream seepage; however, since the reservoir was dry, no conclusive determination could be made.

The 18" corrugated pipe which passes through the dike embankment was clean and in good condition. The top-hinged flap gate located on the reservoir end of the pipe was also in good working condition.

### d. Reservoir Area

The reservoir, which was dry at the time of the inspection, primarily consists of open grass fields and wooded areas, with a few residential homes bordering it.

# e. Downstream Channel

The channel just downstream from the principal spillway was clean with some minor brush growth along the slopes (Photo 8). The downstream channel area is flat and mostly undeveloped.

# 3.2 Evaluation

The general condition of the dam and appurtenant structures is good, based upon the visual inspection. The following features could influence the future condition and/or stability of the structure.

- Continued vehicular traffic along the dam and dike embankments and emergency spillway could lead to erosion problems.
- Further erosion of the dam embankment may result in decreased structural stability, especially in the vicinity of the principal spillway.
- 3. The year-round wet condition in the area of the seepage drain outlet nearest the emergency spillway may lead to slope sloughing and structural instability.

- 4. Additional siltation of the outlet seepage drain at the principal spillway may lead to the stoppage of seepage flow through the drainage blanket.
- The additional accumulation of debris at the trash rack on the intake riser could result in a serious decrease of flow through the principal spillway and a build-up of water in the reservoir area.
- 6. The absence of one trash rack bar may lead to the accumulation of debris in the intake riser and outlet pipe.
- 7. Increased brush growth along the slopes of the downstream channel and ditches will result in decreased channel flow capacity.
- 8. The depressed and raw earth area on the dike crest may lead to erosion and deterioration of the dike embankment.
- 9. Additional brush growth on the dike embankment slopes could result in decreased structural stability due to increased root development.
- 10. Increased scouring under the concrete cradle may lead to serious undermining of the 30" outlet pipe.

The dam is a flood control project and, therefore, the reservoir is dry except during periods of heavy rainfall. With the reservoir dry, the inspection could not reveal seepage conditions. Thus, this inspection cannot in any way evaluate the seepage conditions that may exist when water is impounded in the reservoir.

# OPERATIONAL AND MAINTENANCE PROCEDURES Section 4

#### 4.1 Operational Procedures

#### a. General

There are no operational procedures such as dam surveillance or reservoir level readings at this time. The spillways were designed to be uncontrolled and, therefore, do not have any operational procedures.

b. Description of any Warning System in Effect
There are no warning systems in effect.

### 4.2 Maintenance Procedures

#### a. General

The Town of Bloomfield leases the Blue Hills Reservoir area from the State of Connecticut Department of Environmental Protection and is responsible for general maintenance. A copy of the lease is available from the State of Connecticut Department of Environmental Protection, or the Town of Bloomfield.

The Town mows the dam and dike embankments and the emergency spillway semi-annually, whereas the upstream and downstream channels are generally cleaned and cleared of debris and brush annually. The grass fields within the reservoir area are moved annually by a private farmer.

The dam is inspected annually by representatives from the State of Connecticut Department of Environmental Protection, the U.S. Soil Conservation Service and the Town of Bloomfield. A copy of the latest inspection report is included in Appendix B.

#### b. Operating Facilities

Although the Town of Bloomfield leases the reservoir area, the State of Connecticut Department of Environmental Protection has charge of the construction, operation, and structural repair of the flood control works.

#### 4.3 Evaluation

The operational and maintenance procedures are generally satisfactory but there are areas requiring improvement. A formal operational procedure with continuing records and a downstream emergency warning plan should be developed by the State of Connecticut Department of Environmental Protection. A formal maintenance procedure with continuing records should also be developed by the State of Connecticut Department of Environmental Protection with the Town of Bloomfield to insure the continued safety of the dam. A list of recommended procedures for the operation and maintenance of the dam is given in Section 7.

# EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES Section 5

#### 5.1 General

Blue Hills Reservoir was created along with three others in the Bloomfield, Connecticut area in 1974 to reduce potential flooding in the watershed area of the North Branch of the Park River. Detailed designs were prepared for the U.S. Department of Agriculture, Soil Conservation Service by Anderson-Nichols, Consulting Engineers.

The reservoir has a contributory watershed area of 1.90 square miles which is practically flat with an average slope under 1%. Most of this area is developed, having a good number of town and state roads, houses and other buildings spread over it.

The Blue Hills Dam is a 4,045 ft. long earth embankment with a maximum height of 24.5 ft. It consists of a compacted core, a drainage blanket, a cutoff trench, and a seepage drain system. There is a two stage reinforced concrete intake riser with the 30" reinforced concrete pipe outlet acting as the principal spillway, and a trapezoidal grassed channel, 210 ft. wide at the control section, serving as the emergency spillway. The combined spillway capacity is 9,400 cfs before overtopping of the dam occurs. The spillway capacity at the routed test flood elevation of 111.8'MDC Datum is 1,570 cfs. The crest elevation of the dam is 116.1'MDC Datum, which is 6.1 ft. higher than the emergency spillway crest elevation of 110.0'MDC Datum.

#### 5.2 Design Data

Detailed plans, the as-built drawings, and the original design report prepared by Anderson-Nichols, Consulting Engineers, are available at the Soil Conservation Service office in Storrs, Connecticut. These documents contain the necessary design data. It appears that some changes were made at the time of construction. Particularly noticeable were the width of the emergency spillway at the control section which was changed from 150 ft. to 210 ft., and the design high water elevation changed from 114.1' to 112.4'MDC Datum. The original design test flood inflow for Blue Hills Dam was 7,535 cfs. and the routed outflow was 1,455 cfs. The original design high water elevation in the reservoir was set at 114.1'MDC Datum, giving a freeboard of 2.0 ft.

#### 5.3 Experience Data

There are no known records of reservoir levels during the times that water has been impounded at Blue Hills Dam.

#### 5.4 Test Flood Analysis

Based on the dam failure analysis, the dam is classified as being 'High' hazard potential in accordance with Table 2, on page D-9 of the Corps of Engineers Recommended Guidelines for Safety Inspection of Dams. The test flood should be equal to the probable maximum flood (PMF) which was accordingly adopted for analysis.

An inflow flood peak of runoff was calculated for the 1.90 square miles watershed area using the guide curves for "flat and coastal" terrain, supplied by the Corps of Engineers. The peak flow of 950 cfs per square miles (csm) was read from the curve which gave the PMF as  $950 \times 1.90 = 1,800$  cfs.

A triangular hydrograph was constructed, using the methodology given in the "Hydrology, Section 4, Soil Conservation Service National Engineering Handbook". The peak inflow rate of 1,800 cfs and a total runoff of 19.0" for the PMF were used to construct the inflow hydrograph.

The flood was then routed through the reservoir, assuming an initial water elevation of 110.0 ft MDC Datum, which was at the crest of the emergency spillway control section.

The test flood produced a maximum outflow discharge of 1,570 cfs which is far below the maximum spillway capacity of 9,400 cfs which is 600% of the former. The peak flood test pool elevation of 111.8 ft. MDC Datum results in a 4.3 ft. freeboard to the top of dam.

#### 5.5 Dam Failure Analysis

A dam failure analysis was made using the guidelines provided by the Corps of Engineers. Failure of the dam was assumed with water level at the test flood pool elevation of 111.8 ft.

MDC Datum and a prefailure routed outflow of 1,570 cfs. Assuming a dam breach size of 20 ft. high and 1,620 ft. wide (40% of dam length), the peak release rate into the downstream valley was 243,000 cfs.

The height of the flood wave came out to be approximately 16 ft. at the first cross-section (sta. 18+00). Three cross-sections were analyzed, the last one being 3,500 ft. downstream from the dam. Flood routing computations were done taking into consideration the available valley storage. The resulting flood elevations and the values of the routed flood flows are shown

in Appendix D. Although the flood flow goes down to 63,000 cfs at the last cross-section, the valley slope is very flat and the flood wave height was found to be about 16 ft. at this location. A large number of buildings and several streets will be flooded as a result of dam breach.

The depths of flow in the brook in the vicinity of 47 downstream houses considered (the last one being 3,500 ft. from the dam), range as follows:

	Pre-Failure Depth	Post Failure Depth
First 10 houses:	4.5 ft.	16.0 ft.
Next 21 houses:	4.5 ft.	17.0 ft.
Next 16 houses:	5.0 ft.	16.5 ft.

None of these houses are subject to potential flooding under the test flow condition. In case of dam failure, they will be flooded to depths which range up to 4 ft. above their first floor elevation.

The dam is classified as 'High' hazard potential. Its failure could result in loss of more than a few lives and excessive economic loss.

Dam breach computations are shown in Appendix D.

1

# EVALUATION OF STRUCTURAL STABILITY Section 6

#### 6.1 <u>Visual Observation</u>

The visual inspection revealed no apparent structural stability problems; however, two areas of concern were noted.

Standing water at the seepage drain outlet nearest the emergency spillway poses a concern. The cattails and standing water at the outlet indicate that this wet condition may be year-round, even though the reservoir is normally dry. This outlet is located at what appears to have been the prior path of a small stream which was relocated along the upstream side of the dam embankment. A drainage channel may exist under the dam embankment from the stream in the reservoir area to the underdrain outlet. Such a drainage path could endanger the dam stability, especially during periods of heavy rainfall.

The rutting on top of the embankments has resulted in minor slope erosion. Such rutting, if allowed to continue, could cause serious erosion damage. The water in the ruts tends to accumulate at low spots and flow down the embankment slopes in concentrated gullies.

The reservoir was dry at the time of inspection; therefore, any seepage that may exist when water is impounded
in the reservoir could not be observed.

#### 6.2 Design and Construction Data

A review of the available data indicates that the dam and dike were adequately designed for structural stability.

## 6.3 Post Construction Changes

The available data does not indicate any post construction changes.

## 6.4 Seismic Stability

The dam is located in Seismic Zore No. 1, and in accordance with Corps of Engineers' guidelines does not warrant further seismic analysis at this time.

# ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES Section 7

#### 7.1 Project Assessment

#### a. Condition

Based upon the visual inspection of the site, review of available data and past performance, the project appears to be in good condition. No evidence of structural instability was observed. The dam, dike and spillway are generally in good condition with areas of some concern requiring further study, or maintenance and/or monitoring.

Any structural instability that might occur due to seepage when the reservoir contains floodwater could not be evaluated due to the dry condition of the reservoir.

Based upon "Preliminary Guidance for Estimating Maximum Probable Discharge" dated March, 1978, peak inflow to the lake is 1,800 cfs; peak outflow is 1,570 cfs with the water level 4.3 feet below the dam crest. Based upon our hydraulic computations, the spillway capacity with the pool level to the top of dam is 9,400 cfs, which is equivalent to approximately 600% of the routed test flood outflow.

#### b. Adequacy of Information

The information available is such that an assessment of the condition and stability of the project can be made.

#### c. Urgency

It is recommended that the measures presented in Section
7.2 and 7.3 be implemented within two years of the owner's receipt

of this report.

#### 7.2 Recommendations

It is recommended that the owner employ a qualified registered engineer to:

- Inspect the dam during the time that water is impounded in the reservoir with particular attention to locating any possible seepage.
- Determine the origin and significance of the standing water at the seepage drain outlet nearest the emergency spillway.
- 3. Design a permanent surface on the dike embankment at the utility service road crossing capable of carrying traffic without rutting or eroding.

The owner should implement the recommendations of the engineer.

#### 7.3 Remedial Measures

#### a. Operation and Maintenance Procedures

The following measures should be undertaken within the time period indicated in Section 7.1.c., and continued on a regular basis.

- Surveillance should be provided by the owner during periods of unusually heavy precipitation and high discharge. The owner should develop and implement a downstream warning system to be used in case of emergencies at the dam or dike.
- A formal program of operation and maintenance procedures should be instituted and fully documented to provide accurate records for future reference.

- 3. A comprehensive program of inspection by a registered professional engineer qualified in dam inspection should be instituted on a biennial basis.
- 4. Remove brush from upstream and downstream ditches at dam. Remove brush from upstream and downstream channel within 30 feet of toe of slope of dam.
- 5. Remove brush from the crest, slopes and within 10 ft. of the toe and heel of the north portion of the dike.
- Remove debris and replace missing rod at trash rack.
- 7. On the emergency spillway, fill in minor erosion gullies and vehicular scars and reestablish sod and vegetation.
- Expose and/or clean out outlet seepage drains, where required.
- 9. Fill in ruts and minor erosion gullies on the dam and dike embankments and reestablish sod and vegetation.
- 10. Fill in the small scour pocket under the 30" outlet pipe.

#### 7.4 Alternatives

This study has identified no practical alternatives to the above recommendations.

## APPENDIX A

INSPECTION CHECKLIST

# VISUAL INSPECTION CHECK LIST PARTY ORGANIZATION

PROJECT Blue Hills Dam	DATE 12/15/80
	TIME Morning
	WEATHER Sunny , 205
	W.S. ELEVU.SDN.S
PARTY:	
	DISCIPLINE:
1. Ramesh Singhal (RS)	•
2. Ed Henderson (EH)	Geotechnical
3. Wesley J. Wolf (WW)	Hydraulics
4. Genald F. Buckley (GB)	Soils & Structures
5	<u>:</u>
PROJECT FEATURE	INSPECTED BY
1. Dam Embankment (Earthfill	1 RS, EH, WW, GB
2. Principal Spillway - Intake R	isca RS, EH, WW, GB
3. Principal Spillway - Outlet	RS, EH, WW, GB
4. Emergency Spillway	RS, EH, WW, GB
5. Dike Embankment (Earth Fil	1) RS, EH, WW, GB
6	
7	
8	
9	
10	

PROJECT Blue Hills Dam	DATE 12/15/80
PROJECT FEATURE Earth 5:11 Dam	NAME RE EH WW. GB
DISCIPLINE	NAME

AREA ELEVATED	CONDITIONS
DAM EMBANKMENT	
Crest Elevation	116.1 1 MOC Datum
Current Pool Elevation	No Pool - Dry Dam
Maximum Impoundment to Date	Unknown
Surface Cracks	None Observed
Pavement Conditions	N/A
Movement or settlement of crest	None Observed (Vehicle Rut
Lateral movement	None Observed
Vertical alignment	Looks Good
Horizontal alignment	Looks Good
Conditions at abutment & at Comcrete Structures	Good
Indications of Movement of Structural Items on Slopes	None
Trespassing on Slopes	Moderate
Sloughing or Erosion of Slopes <del>or</del> Abutments	Minon Erosion
Rock Slope Protection-Riprap Failures	N/A
Unusual Movement or Cracking at or Near Toes	None Observed
Unusual Embankment or Downstream Seepage	'Only at One Underdrain Outlet.
Piping or Boils	None Observed (Dry Dam)
Foundation Drainage Features	One Outlet Covered, Two
Toe Drains	Partially Full 05 Silt'
Instrumentation System	- Value

PROJECT Blue Hills			17/15/8D RS, EH, WW, GB
DISCIPLINE	KIST & CHANNE	NAME	K + E (1 + 60 (9 + 92)

AREA EVALUATED	CONDITION
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	
Slope Conditions Bottom Conditions Rock Slides or Falls Log Boom Debris Condition of concrete lining Drains or Weep Holes Intake Structure	Natural & Brook Relocation  Some Brush  Some Brush  None  N/A  Minor at Intake Structure  N/A  N/A  N/A  Concrete Riser For Pipe
Condition of Concrete	Good Good
Stop-Logs_and-Slots	Minor Debris at Trash Rack one Bar From Trash Rack is Missing.

PROJECT Rlue Hills Dam	DATE 12/15/80
FROJECT FFATIRE Outlet Channel	NAME RS, EH, WW, GB
DISCIPLINE	NAME

NAME
CONDITIONS
No Outlet Structure, Flow Discharges From Pipe onto Rip-Rap  Excavated Outlet Channel Little Brush on edge Satisfactory - Very Minon Bank Erosion

PROJECT Blue Hills Dam	DATE 12/15/80
	Iway NAME RS, EH, WW, GR
DISCIPLINE	NAME

AREA EVALUATED		CONDITION		
0U1	LET WORKS - SPILLWAY WEIR, APPROACH WD DISCHARGE CHANNELS			
a.	Approach Channel (Before Crest			
	General Condition	Good - Some Vehicle Marks		
	Loose rock overhanging channel	None		
	Trees Overhanging Channel	None		
	Floor of Approach Channel	Good		
٠.	Weir and trailing walls	$\Box$		
	General Condition of Concrete			
	Rust or Staining			
	Spalling	- NA		
	Any Visible Reinforcing			
	Any Seepage or Efflorescence			
	Drain Holes			
•	Discharge Channel (After Crest)			
	General Condition	Good - Minor Vehicle Marks		
	Loose Rock Overhanging Channel	None		
	Trees Overhanging Channel	None		
	Floor of Channel	Good-Minon Vehicle Marks		
	Other Obstructions	None		
	·			
		•		
	٠.			
	A-S	* Note: Emergency Spillway is Grass Covered Fanth		

PERIODIC INSPECT	TION CHECK LIST
PROJECT Blue Hills Com	DATE 12/15/00
PROJECT FEATURE Earth Fill Ditc	•
DISCIPLINE	
,	
AREA EVALUATED	CONDITION
DIKE EMBANKMENT	
Crest Elevation	116.1 1 MOC DATUM
Current Pool Elevation	None - Dry Lam
Maximum Impoundment to Date	Unknown
Surface Cracks	None Observed
Pavement Conditions	N/A
Movement or settlement of crest	Settlement at Utility Access Road over Road Ruts along crest
Lateral movement	
Vertical alignment	None Observed Depression at Utility Acces
Horizontal alignment	Road Looks Good
Conditions at abutment & at Concrete Structures	N/A
Indications of Movement of Structural Items on Slopes	N/A
Trespassing on Slopes	Minon
Sloughing or Erosion of Slopes <del>or</del> -Abutments-	Very Minor Erosion by Water From Wheel Ruts
Rock Slope Protection-Riprap Failures	N/A
Unusual Movement or Cracking at or Near Toes	None observed
Unusual Embankment or Downstream Seepage	None Observed (Ony Dam)
Piping or Boils	None Observed (Dry Dam)
Foundation Drainage Features	N/A
Toe Drains	N/A
Instrumentation System	N/A
A-6	

APPENDIX B

ENGINEERING DATA

## ENGINEERING DATA CHECKLIST

ITEM	AVAILABILITY	LOCATION
ITEM		
LOCATION MAP	Available	Metropolitan District Commission, Hartford, CT
AS-BUILT DRAWINGS	Available	U.S. Soil Conservation Service Storrs, CT.
HYDROLOGIC & HYDRAULIC DATA	Available in Design Report	
SOIL BORINGS	Available in Design Report	
SOIL TESTING	Available in Design Report	
GEOLOGY REPORTS	Available in Design Report	
CONSTRUCTION HISTORY	Not Available	
OPERATION RECORDS	Not Available	
INSPECTION HISTORY	Available	State of Connecticut Department of Environmental Protection
DESIGN REPORT	Available	U.S. Soil Conservation Service Storrs, CT.
DESIGN COMPUTATIONS		
HYDROLOGIC & HYDRAULIC	Available in Design Report	
DAM STABILITY	Available in Design Report	
SEEPAGE ANALYSIS	Available in Design Report	

#### DESIGN REPORT

NORTH BRANCH PARK RIVER
WATERSHED PROTECTION PROJECT
RETARDING STRUCTURE - SITE NO. 2
BLUE HILLS DAM
BLOOMFIELD, CONNECTICUT

The site of this proposed floodwater retarding structure is located approximately 1.3 miles northeast of Bloomfield Town Hall and 0.8 miles northwest of the intersection of Wintonbury and Blue Hills Avenues. The dam is situated on the easterly branch of Beamans Brook, a tributary of the North Branch of Park River.

The geographic location of this site may be found on the Metropolitan District Geodetic and Topographical Survey Sheet 235, published by the Commission on Regional Planning, Hartford County, Connecticut, by scaling 4.1 inches north (latitude 41° 50° 23.1" north) and 6.3 inches west (longitude 72° 42′ 46.8" west) from the lower right-hand corner of the sheet. Sheet 5 of this report is an overlay which when placed on the appropriate latitude and longitude of the Metropolitan District Geodetic and Topographical Sheet 235 will locate the proposed dam.

This dam designed as a class "C" structure, has a watershed of 1,215 acres. It is to be constructed of compacted earthfill on a foundation of non-plastic medium dense silts and silty fine sands. The principal spillway will be a single stage drop inlet spillway with a reinforced concrete pipe 30 inches in diameter and a reinforced concrete riser with 2.5 ft. x 7.5 ft. inside dimensions. It will rest on a foundation of sandy silts and fine sands.

Am emergency spillway with a base width of 150 feet and crest elevation at 112.0 feet (MDD) will also be provided. The maximum velocity at the control section of the emergency spillway will be 6.03 feet per second for the design flood. The frequency of use will not exceed a one percent chance.

A rectangular low flow orifice, 1 ft. x 2.5 ft., will be provided in the face of the riser to pass base flow of the stream and maintain a "dry" sediment pool. The invert elevation of the low flow orifice is set at 96.0 feet (MDD) on the assumption that the accumulation of sediment will be negligible in the vicinity of the principal spillway. The crest of the riser is set at elevation 100.0 feet (MDD). The riser was used to provide a simple means of Vortex Control and to facilitate the construction of an adequate trash rack.

The drawdown time was computed to be 7.19 days from the crest of the emergency spillway to the crest of the riser.

This is to be a dry reservoir (no permanent pool) but a drainage blanket with a toe drain is provided.

The flood routing procedure used in the design is described in Engineering Handbook, Section 5, Hydraulics, U. S. Department of Agriculture, Soil Conservation Service.

The flood routing procedure was used to determine the maximum stages shown in the table on page 3.

	<del></del>	<del></del>		<del></del>	<del></del>	
Factor Which Determines Stage	Surface Area Acres	Runoff in Inches	Peak Inflow CFS	Elev. of Max. Stage Ft.	Storage Ac. Ft.	Element of Structure Determined by Maximum Stage
				96. 0		Invert of low- flow orifice
	6.			100. 0	••	Crest of Riser
Project Storm (Prin. Spwy. Design)	237	12. 0	3100	112. 0	1098	Crest of Emergency Spillway
1.75x 6 hr. point rain- fall, mos- ture condi- tion III (Emer. Spwy. Design)	291	15. 84	7535	114. 1	1640	Design Highwater
2.5 x 6 hr. point rain- fall, mois- ture condi- tion II (Freeboard Design)	302 348 2/	19. 6	9850	114. 4 116. 1 <u>2</u> /	1730 2180	Top of Dam

1/ Referred to Metropolitan District Datum

1

The reinforced concrete design procedure was based on Engineering Handbook, Section 6, Structural Design U. S. Department of Agriculture, Soil Conservation Service. The data used were for Class B concrete as described in this publication.

ANDERSON NICHOLS & COMPANY

Determined on the basis of State criteria requiring a minimum freeboard of two feet above design highwater elevation.

Anderson-Nichols & Company Subject Design of No. Branch Short No. 3

Port File Company Computed Charles Well Dain Charles WELL

Horard Classication

The dam site is located above & the who upresent from the borness senter is their field. Connecticut. The cree to be assured that flood just sion by the reservoir is well descript and includes a complete of recidential. Commercial and industrial properties.

These Conditions, Make Ent Conservation Service Classide-initions, place the Structure as Class C

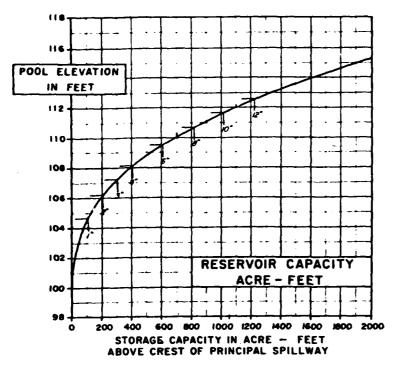
Anderson-Nichols & Company 10 No.C. +5: Book Doto - Hydrograf. 1 Ist-Care Camples Nambers A For Principal Collegery Hydrocoph, Muritur Cordina II Curve Number 85 b For Emergency Opillary Do go 4gdrograph, Soil Con: James Cuterin primit 1956 of Maisture Condition II With Course Mi Es. However, a letter from the Connecticut Whater Resources Commission, dated April 30 1959 to John J M. Zzochi species that in determining this hydrograph the rate - retention a total proup taken loss may not exceed 0.25 inches per hour to order to soristy this Cordition the Curr No. 1: raised to 38 C. For Eminery Spillway Freeboard Hydrograph, Musture Condition II. Curs No. 67. 2 Time of Concentration Overland Flow: distance short 1400 st. -1.p. 1.5% relocity taken = O.G. fp. Time = 1400 = 5340 200 Channel Flore distance 11 000 f A. shpe 0.0045, 5 = 0.067 n= 0.04 Ar had roders 1 about 1.75 -1 1:12 = 1.45 1- 1426 . 145 . 167-36 4ps Time = 11000 = 3060 Em Total line 5400 sec = 1.50 hor - Tr. 15 of in hydrocraph Computations B-6

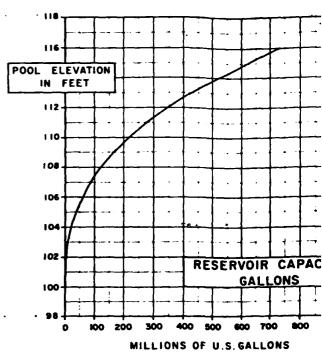
Anderson-Nichols & Company Subject Day 90 C 140 Livering Pork River Ctructure , 1.0C- 143: Cite No. 2 Blue Hills Dain Book Duta to Hude ary 1: Continued 3 Itam Rowtall and Durchan Jan Fred on Spilled by Hytrody pin Port 10-11-011 - 14.75 10 Alest ramall - 13.21 n. Duration - 19 his. 6 Emigency Spillary Deign Hydrograph Duration & he G hr. point, rain-off -in 305-NEH+, Sup. A. Fig. 3.21-1;10.60. 6 hr. raintall for decien = 1.75 x10.6 = 18.55 in. Areal (arrival - 0.936, 18.55 = 17.34 in. C. Emugerry In they Free board Hydro groph Durotism 6 hi 6 hr. point rainfull (source same as about ) = 10.6 m 6 hr. 1 -or hidrograph et - 2.5 x 10 6=265 10. Areal rain-all - 0.735x 26.5- 24.78 in. Sediment Storage Computation Basis - Rate of accumulation in reservoir O.1 ten per occe of draininge aire por year. Dr. Area = 1.90 59 m = 1215 core 50 yr. acc = 0./x 1215 x 50 = 6075 7sn: Dry unit weight = 90 16 per cu. ft 50 yr. nec. Volume = 6075 x 2000 = 3.10 De. 11.

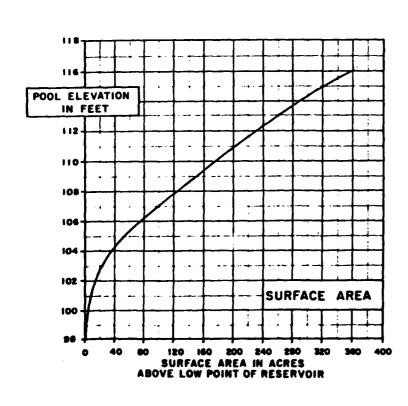
RESERVOIR

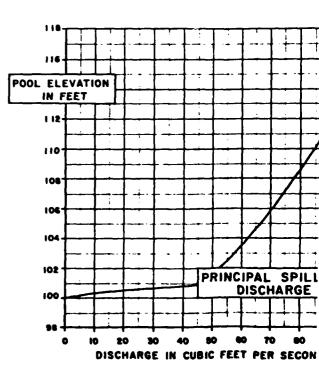
OPERA'

Blue Hills Reservoir - Beaman's Brook - No



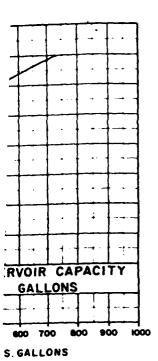


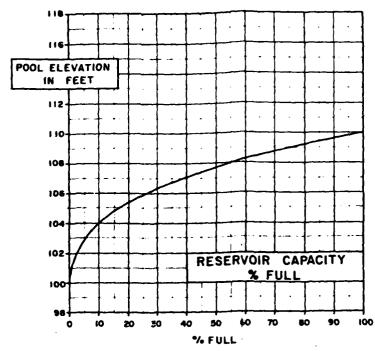




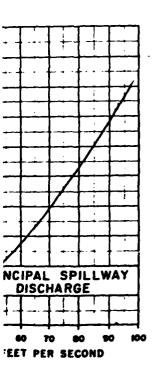
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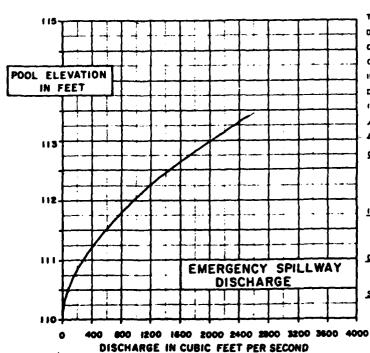
OK - NORTH BRANCH PARK RIVER WATERSHED





#### PERTINENT DATA





TOP OF DAM EL 116.0 EL 112.4 DESIGN HIGH WATER CREST EMERGENCY SPILLWAY EL. 110.0 CREST PRINCIPAL SPILLWAY EL. 100.0 DRAINAGE AREA CONTROLLED 1.90 SO MI. I" OF RUNOFF = 101.33 ACRE-FEET ALL ELEVATIONS REFER TO METROPOLITAN DISTRICT DATUM

CONSTRUCTED BY STATE OF CONNECTICUT DEPARTMENT OF AGRICULTURE & NATURAL RESOURCES JOSEPH N. GILL, COMMISSIONER

IN ASSOCIATION WITH THE U.S.DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE PUBLIC LAW 566 FUNDS

DESIGNED BY ANDERSON - NICHOLS CONSULTING ENGINEERS

STATUS COMPLETED AUGUST 10,1964

## LATER RESOURCES UNIT - D.E.P.

## OPERATION AND HAINTENANCE INSPECTION REPORT

PROJECT: Bloomfie	ld - Blue	Hills Reservoir DAT	E: August 7, 1979
	Conservati	. Warren, J. Kazmarski, Town o on Service; and A. Roberts, V.	f Bloomfield;
ITEI	CONDITION S or U*	HAITTENANCE OR REPAIRS REQUI	RED CO IPLETED
I. Embankments			
A. Vogetation	5		
. Rip rap	, S	_	
C. Drains	5		
II. Principal Scillupy		:	
A. Trasli rack	, S .		
Gates	5		
C. Stilling lasin	3	Cut brush	
J. Conduit	S		
II. Energency Spillway	i i		
A. Vegetation	S		
structions نان.	S		
IY. Outlet Channels	•		
Slove protection	S	<del></del>	
B. Moliris	1 5		
V. Reservoir Area			
h. Deliris	2		
u. Stop lons	N/A		
VI. iiscellaneous			
A. Access road	S		
U. Fences	N/A		

Remarks:

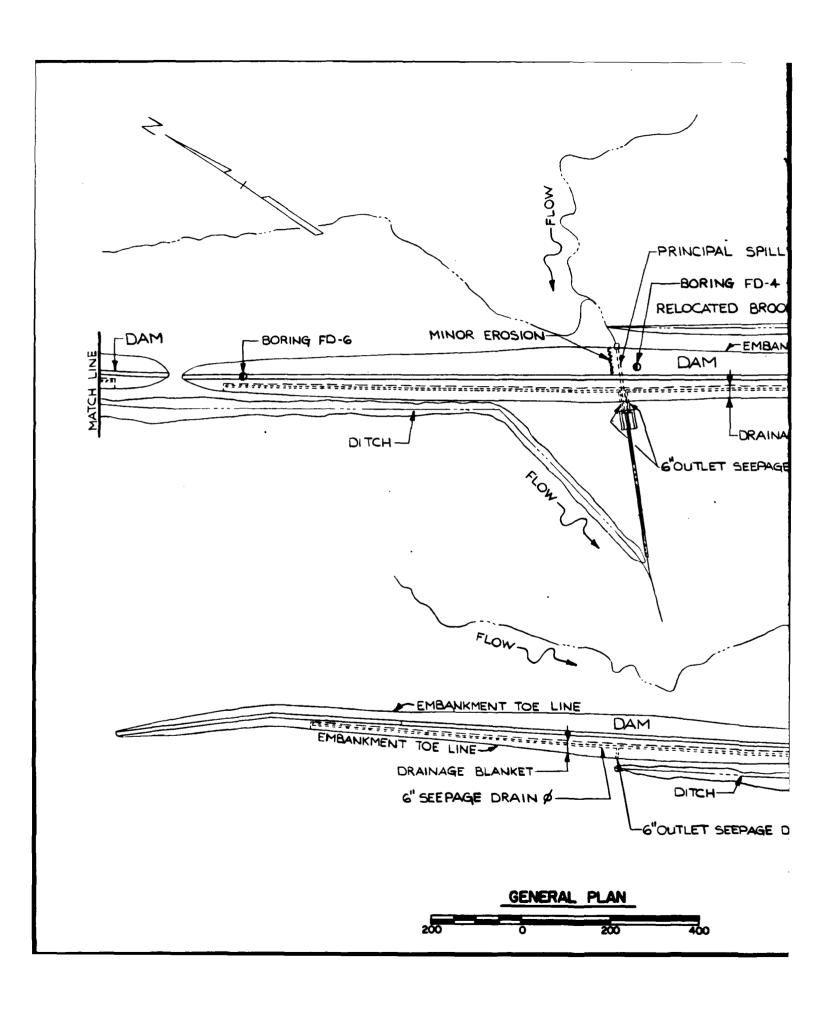
Site well maintained.

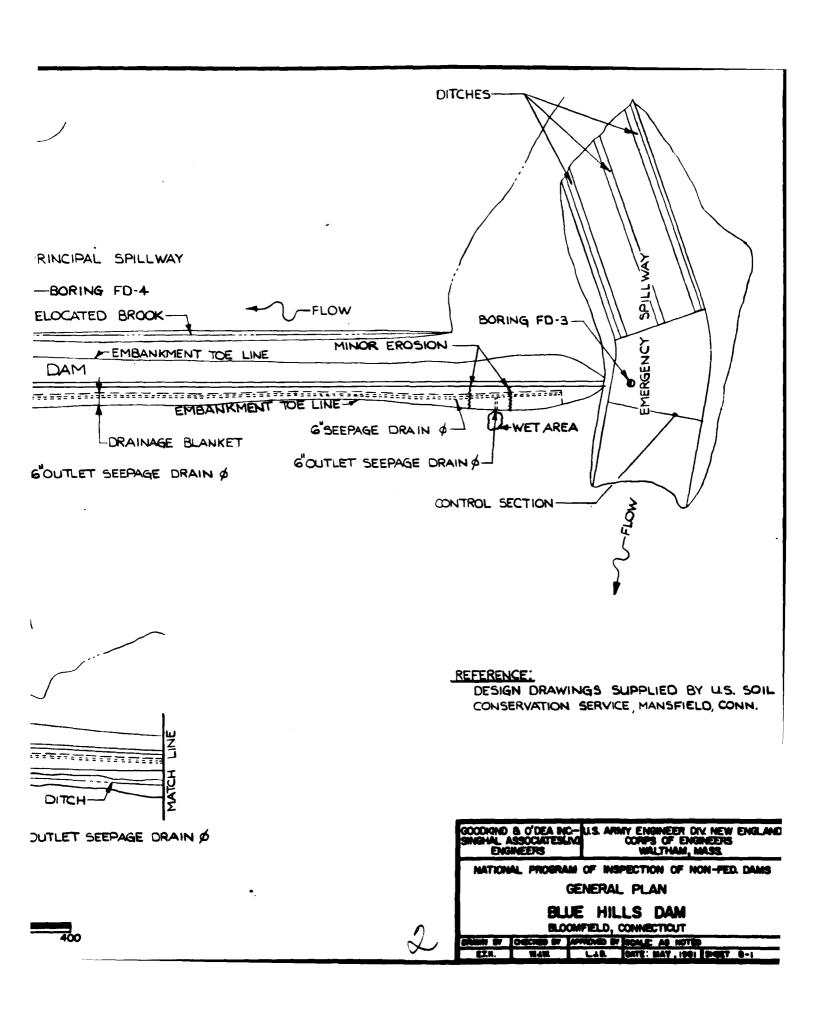
Inspected by: Victor F. Galgowski	Title	Supt. of Dam Haintenance
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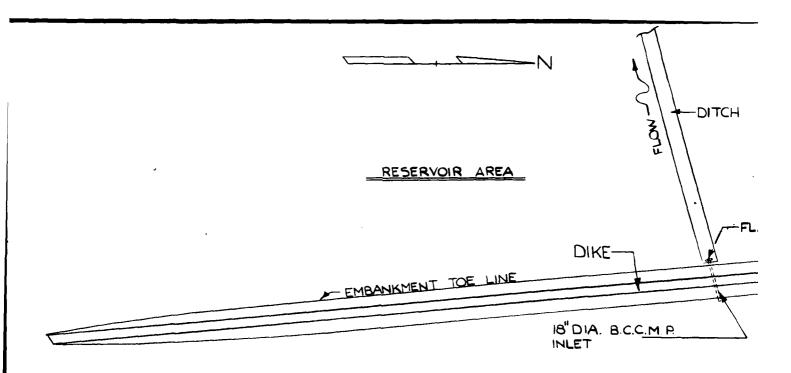
<sup>\*</sup> S = Satisfactory
U = Unsatisfactory
!!A = Hot applicable

#### **BIBLIOGRAPHY**

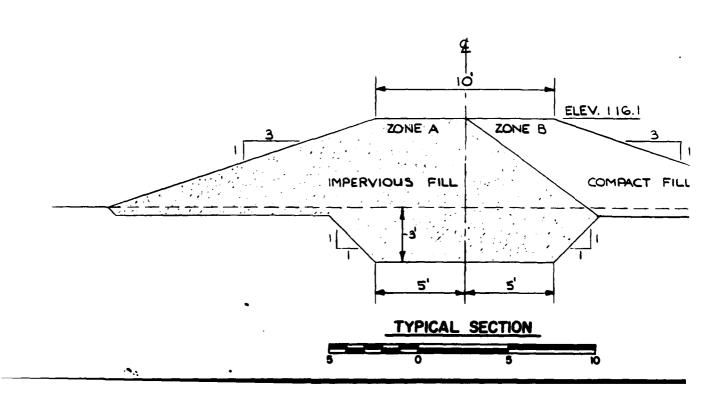
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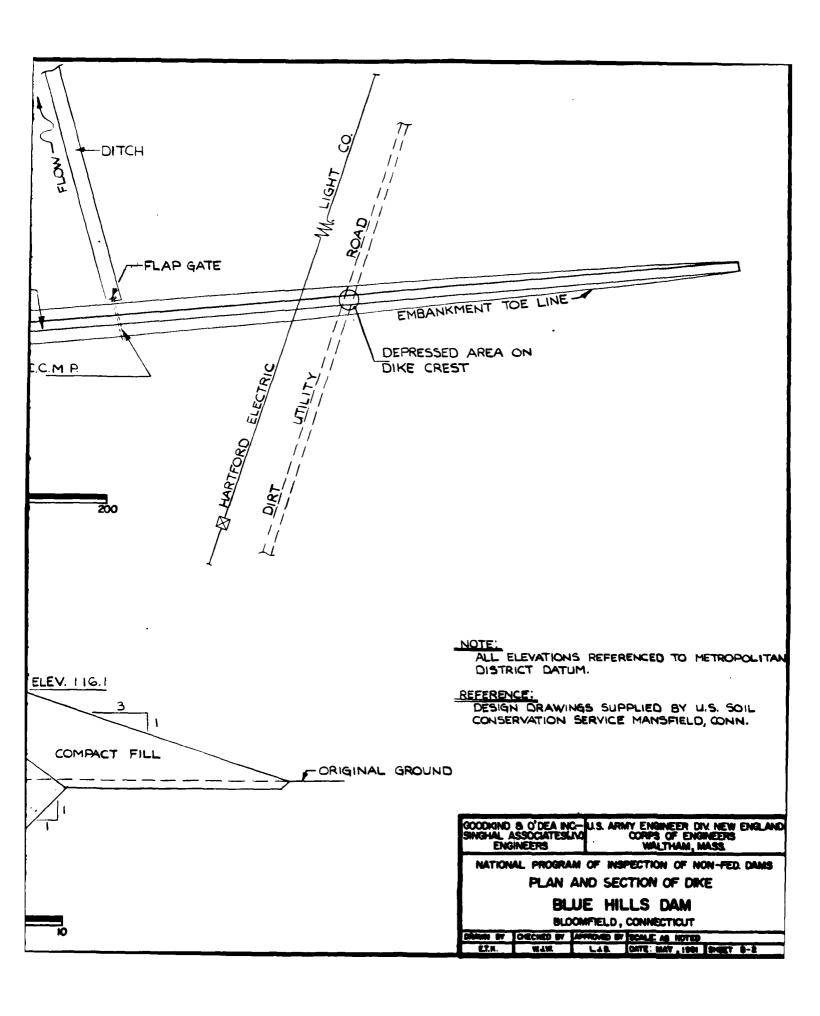


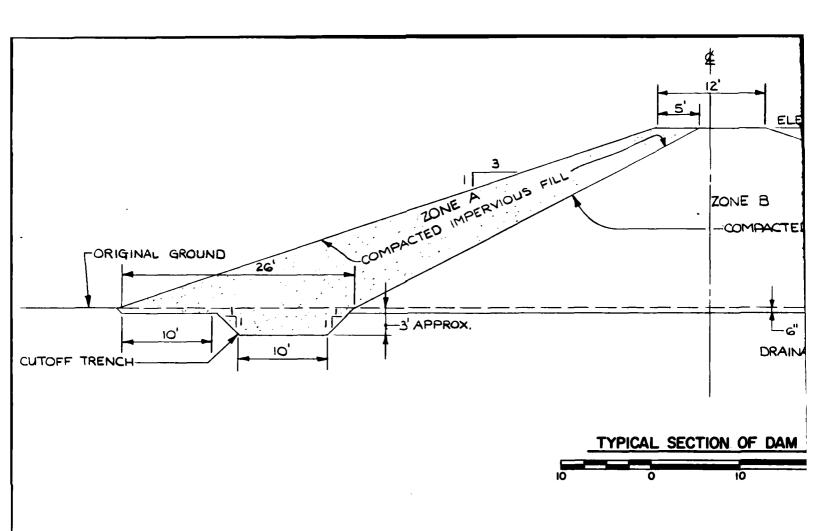


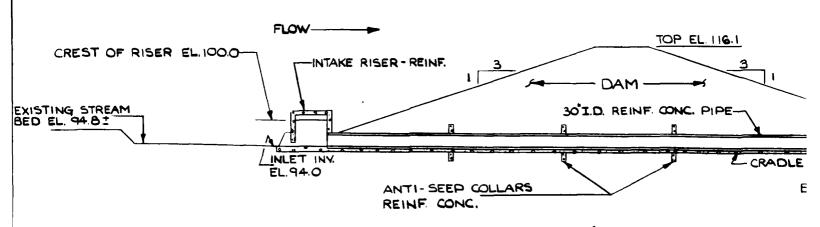






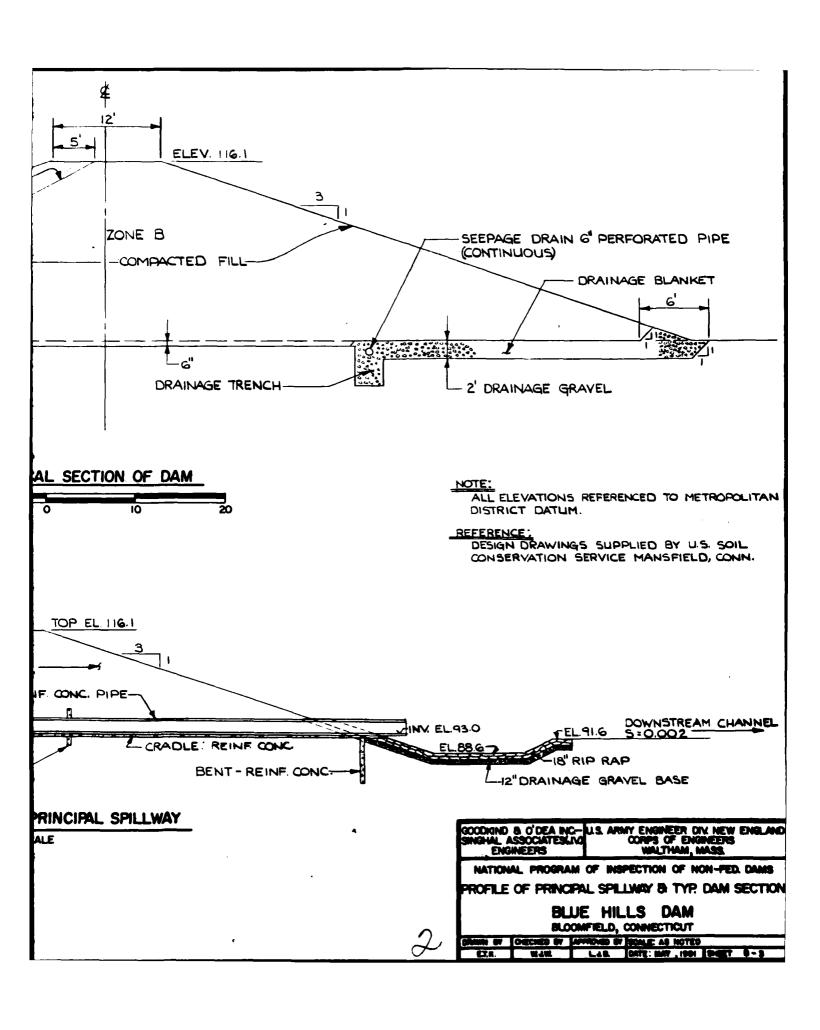


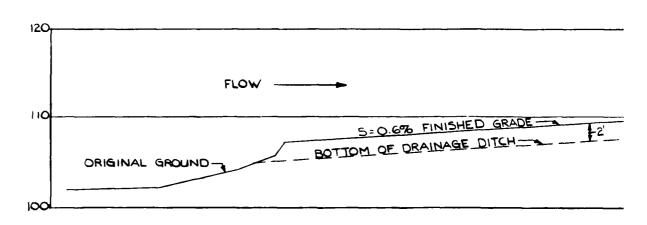


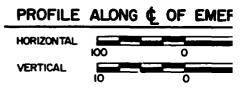


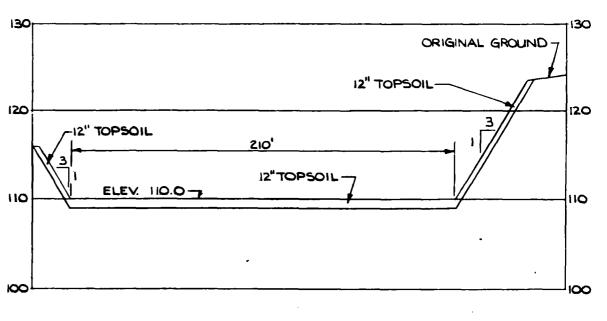
PROFILE ALONG & OF PRINCIPAL SPILLWAY

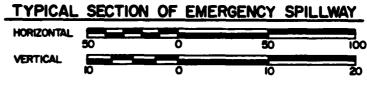
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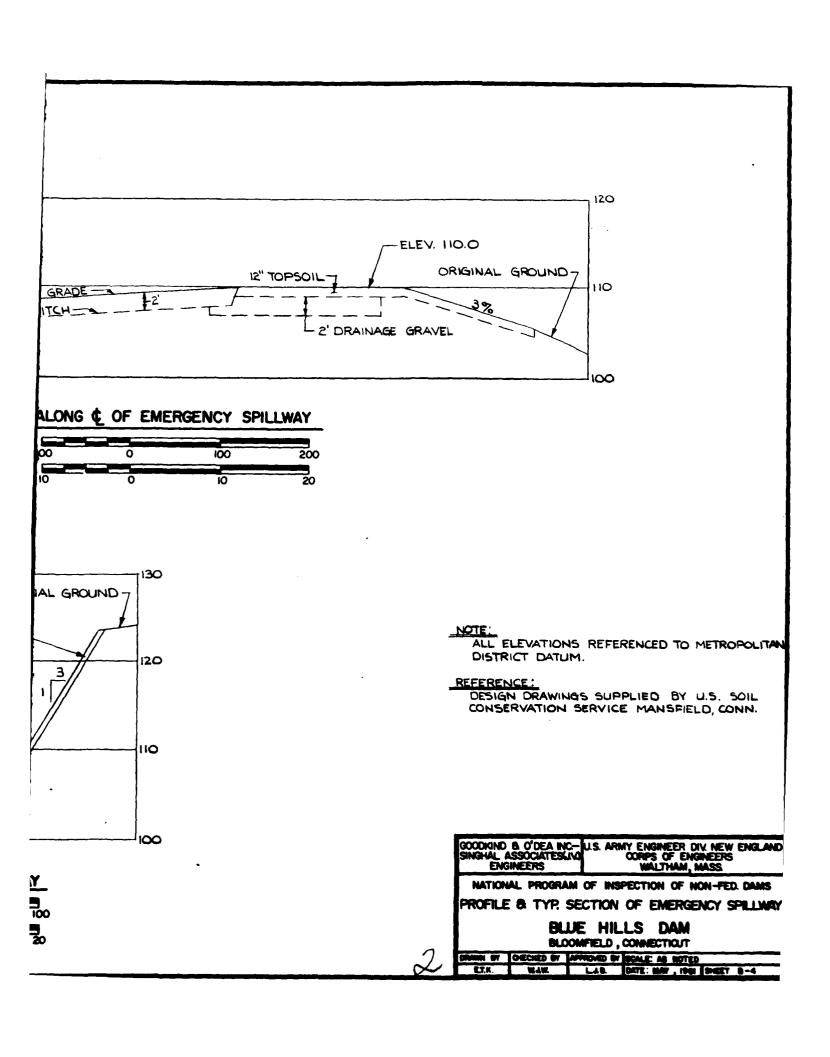


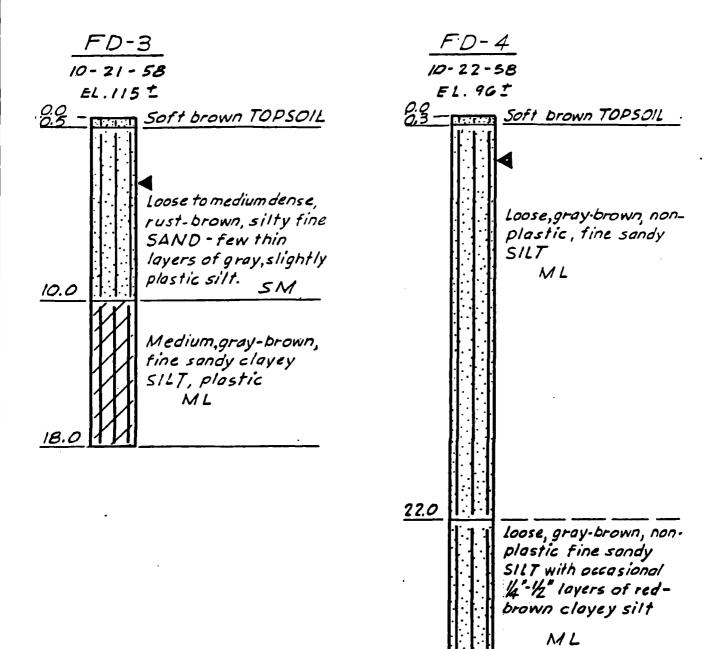












FD-6 10-31-58

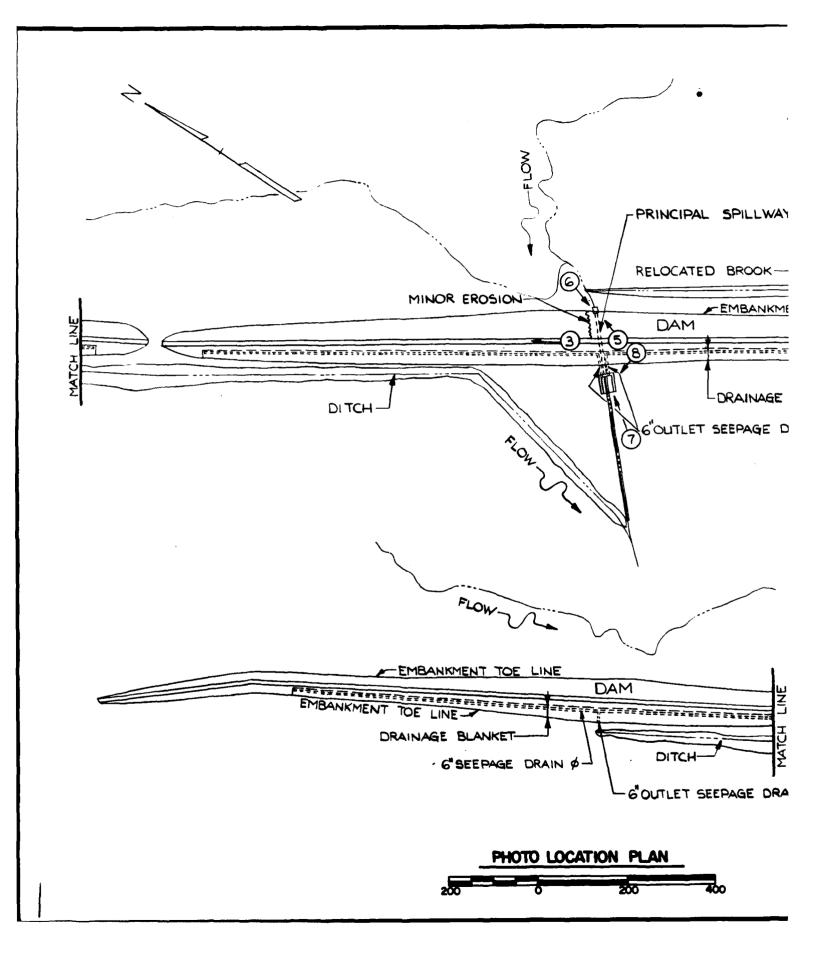
1	0.0 EL.1	05 ±	
OIL.	1.0 []	Soft, black, peoty TOPSOIL	OL.
	5.0	Medium dense, brown, silty. fine SAND	
n, non- ndy		Medium gray, interbedded non-plastic SILT and stightly plastic SILT M L	4
	15.0	[[	
n, non- indy ional red- iilt	35.Q	Medium dense,gray- brown, non-plastic fine sandy SILT, trace of red-brown cloy.  M L	NOTES:  1) ALL ELEVATIONS REFERENCED TO METROPOLITAN DISTRICT DATUM.  2) SEE SHEETS B-1 & B-2 "GENERAL PLAN" FOR LOCATION OF BORINGS.  3) SEE DESIGN DRAWINGS FOR ADDITIONAL BORINGS.  REFERENCE:  DESIGN DRAWINGS SUPPLIED BY U.S. SOIL CONSERVATION SERVICE MANSFIELD, CONN.
		٠.	GOODIAND 8 O'DEA INC-IUS. ARMY ENGINEER DIV NEW ENGLAND SINGHAL ASSOCIATESLIVE CORPS OF ENGINEERS WALTHAM, MASS

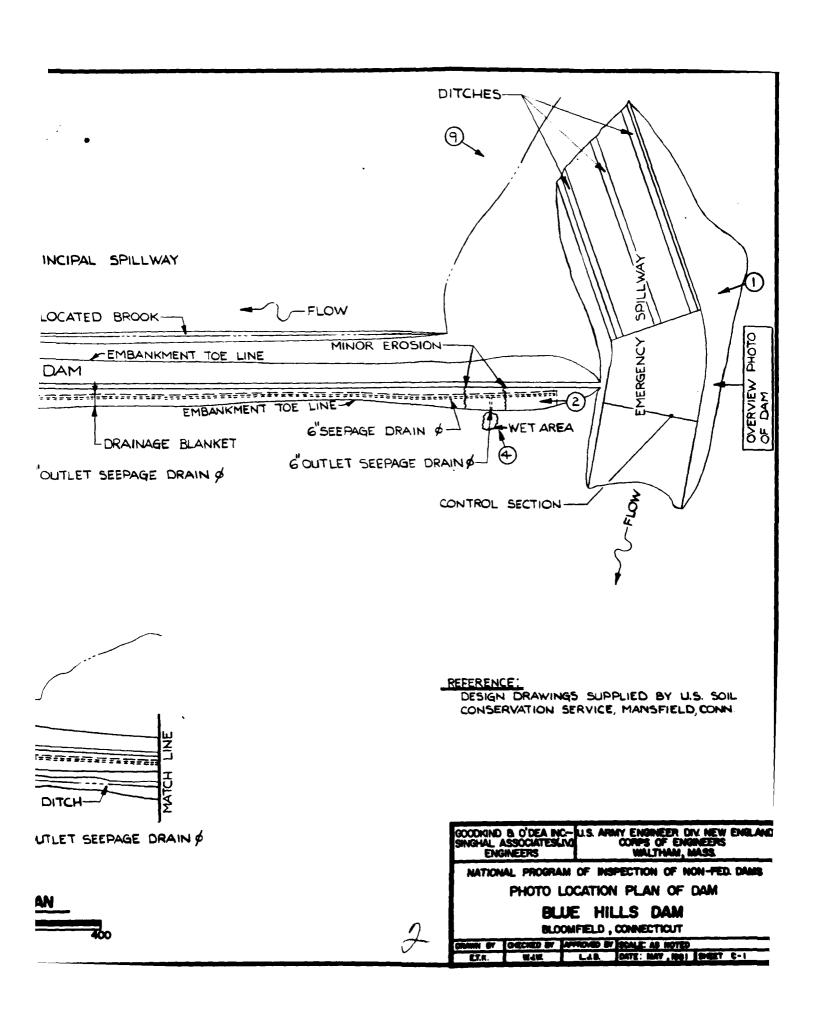
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS TYPICAL BORINGS

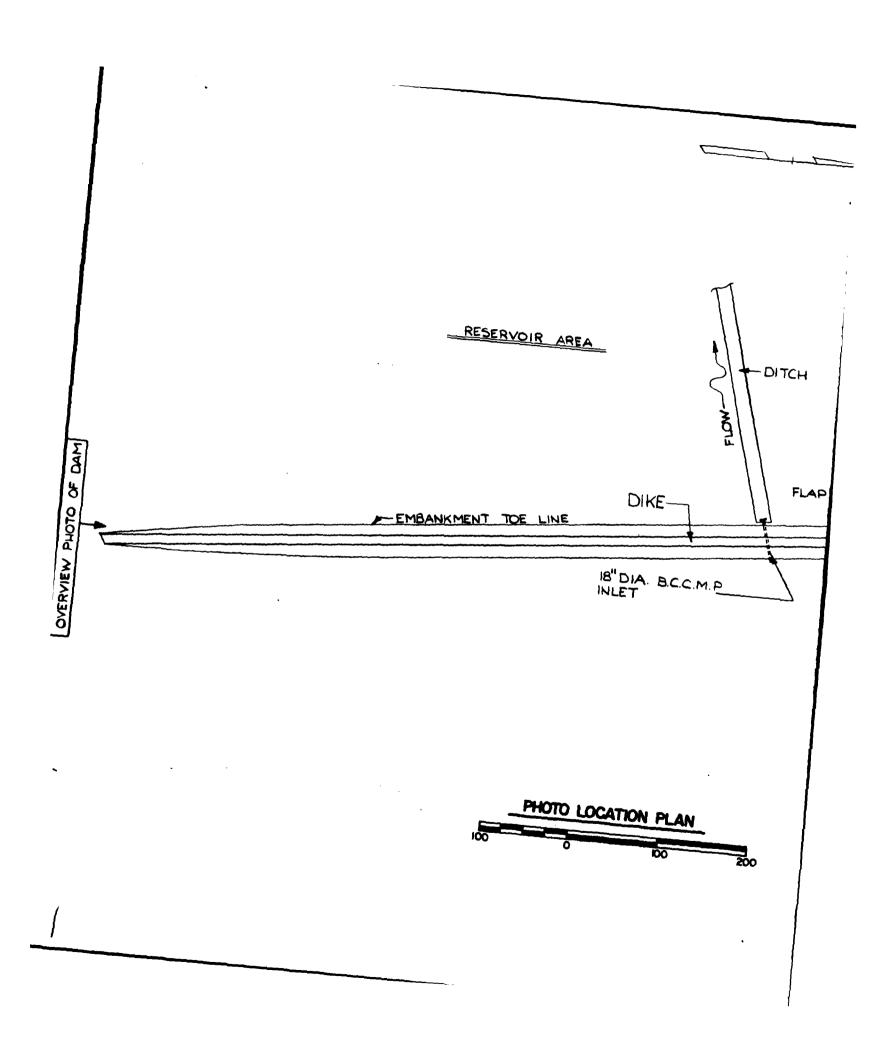
BLUE HILLS DAM BLOOMFIELD, CONNECTICUT

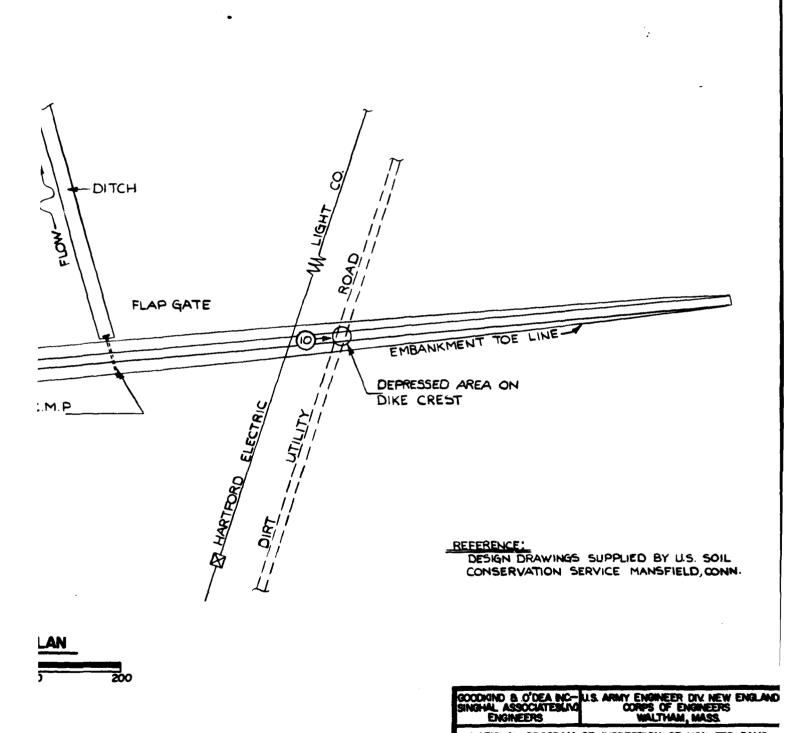
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LTR. WAY LAB DATE: NON ,1001 SHEET 8-9

ET.R. WAW.









NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS
PHOTO LOCATION PLAN OF DIKE

BLUE HILLS DAM
BLOOMFIELD, CONNECTICUT

DAMIN OF GOCIOGO OF PHYSICA OF SOLLE AS NOTED
EXIL. WARE LAR. DATE: MAY, 1901 [SHIET C-2]

#### APPENDIX C

DETAIL PHOTOGRAPHS



PHOTO 1 - View of dam and emergency spillway looking north. Reservoir area on right.

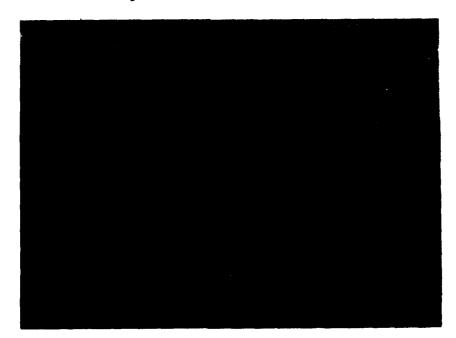


PHOTO 2 - View looking north along the downstream slope of the dam embankment. Note vehicular trespassing.



PHOTO 3 - View at principal spillway looking north along dam crest.
Note vehicular ruts.



PHOTO 4 - Standing water at underdrain outlet. Drain pipe could not be located. Note cattails which indicate that area is wet year-round.



PHOTO 5 - Upstream channel. Relocated brook coming in front right.

Note minor brush growth on channel slopes.



PHOTO 6 - Principal spillway - Intake riser. Note minor debris build-up on trash rack.

ar a war and total



PHOTO 7 - Principal spillway - Outlet Pipe.
Note minor spalling on concrete
pipe and cradle.

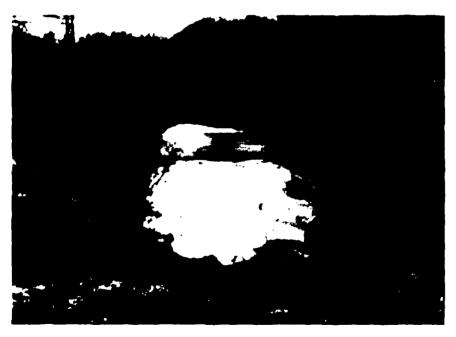


PHOTO 8 - Downstream channel.



PHOTO 9 - View of emergency spillway. Note vehicle trespass on slope.

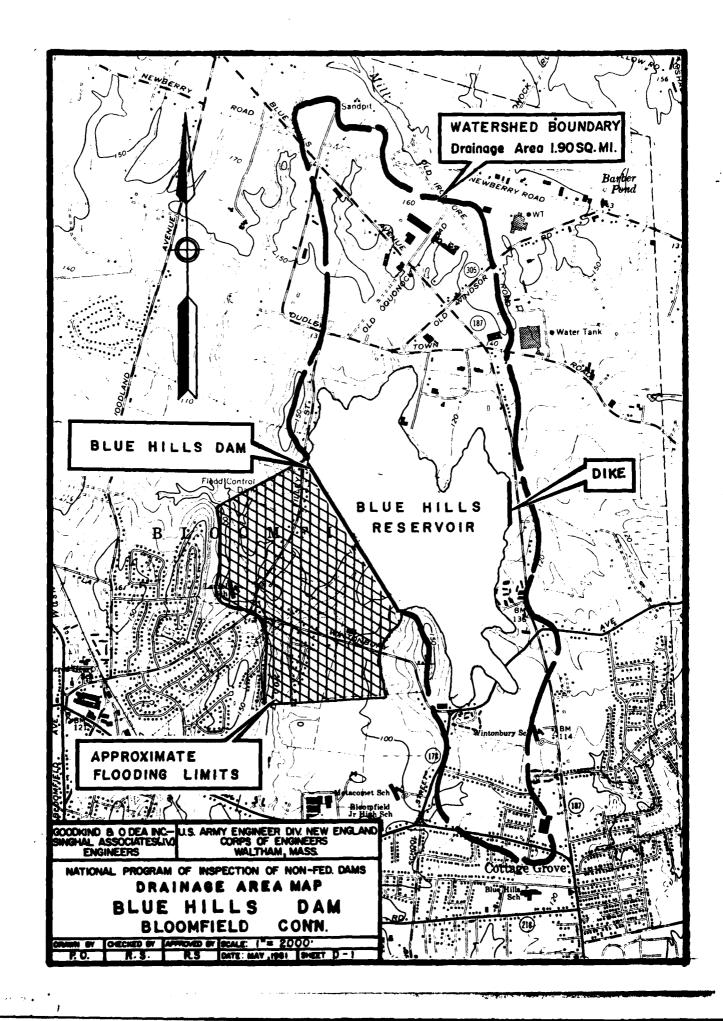


PHOTO 10 - View of dike looking north.

Note brush along slopes and
depressed area at utility
service road.

#### APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS



**CONSULTING ENGINEERS** (CIVIL, HYDRAULICS, SANITARY)

827 N

TEST FLOOD

MAPLEDALE ROAD, ORANGE, CT	06477
TEL: (203) 795-6562	

JOB PLUE HILLS DAM Sheet Number D- 1 Date 12.22.1960 By R.S./GH.

DRAINAGE AREA = 1.90 SQ. MILES

THE DRAINAGE AREA IS FLAT WITH AVERAGE SLOPE UNDER 1%.

FROM THE CURPS OF ENGINEES CHART "FLAT & COASTAL" TERRAIN, THE PROBABLE MAX. FLOOD

PMF = 950 CFS PER SQ. MILE

= 950x 1-90 = 1,800 C.F.S.

#### SIZE AND HAZARD CLASSIFICATION

MAXIMUM HEIGHT OF THE DAM = 24.4 FT. MAXIMUM IMPOUNDMENT UPTO TOP OF DAM = 2200 AC.FT

ALTHOUGH, THE HEIGHT OF THE DAM IS UNDER 40 FT, THE IMPOUNDMENT EXCEEDS 1000 AC. FT. AS SUCH: THE SIZE OF THE DAM = "INTERMEDIATE"

THE HAZARD POTENTIAL IS "HIGH" DUE TO THE EXISTENCE OF SEVERAL IMPORTANT ROADS AND STREETS AS WELL AS A LARGE NUMBER OF HOUSES AND OTHER STRUCTURES ON THE DOWNSTREAM SIDE WHICH WILL BE FLOODED IN CASE OF DAM FAILURE. THERE IS POTENTIAL FOR LOSS OF "MORE THAN FEW" LIVES.

AS PER TABLE 3 PAGES D-12 D-13 OF THE RECOMMENDED GUIDELINES FOR SAFETY INSPECTION OF DAMS' THE RECOMMENDED TEST FLOOD WILL BE PMF = 1800 CFS

. CONSULTING ENGINEERS (CIVIL, HYDRAULICS, SANITARY)

827 MAPLEDALE ROAD, ORANGE, CT 06477 TEL: (203) 795-6562 Job BLUF HILLS DAM
Sheet Number D- 2

Date 12-22-1980

By R.S./G.H.

#### SPILLWAY CAPACITIES

THE SPILLWAY CONSISTS OF THE FOLLOWING:

1-30" R.C. WATER PIPE (UPSTREAM INVERT ELEVATION:94.0 WEIR CREST ELEV- 100.0

1- EMERGENCY SPILLWAY, ZIO FT. WIDE AT CONTROL SECTION, CREST ELEV. 110.0

CAPACITIES AT VARIOUS ELEVATIONS ARE TABULATED BELOW:

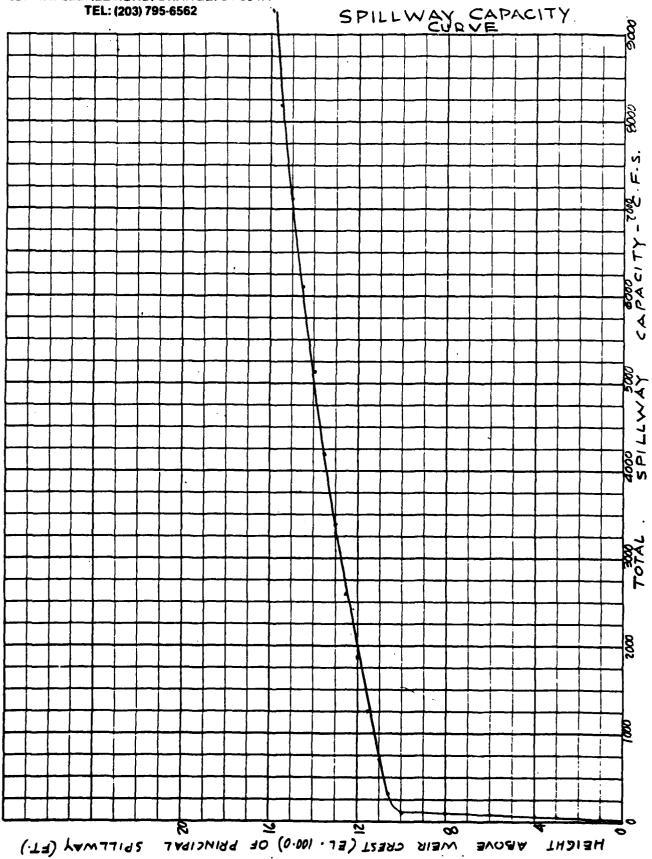
ELEVATION	CAPA	•	F.S.
BLEVATION	PRINCIPAL SPILLWAY	Q = 3.0 LH 12	TOTAL
110.0	85.0	0.0	05-0
110.5	87.0	223.0	310.0
111.0	89.0	630.0	719.0
111.5	90.0	1,157-0	1247.0
112.0	91-0	1782-0	1873.0
112.5	93.0	2490.0	25830
113.0	94.0	3,274.0	3368.0
113.5	25.0	4,125.0	4,220.0
114.0	%.0	5040.0	5,136.0
114.5	98.0	6014.0	6,112-0
/ 115.0	100.0	7,044.0	7,144-0
115.5	102-0	8126.0	8,228.0
116.0	104.0	9,259.0	9363.0

**CONSULTING ENGINEERS** (CIVIL, HYDRAULICS, SANITARY)

Job BLUE HILLS DAM Sheet Number D-3 Date 17-72-1980 By RS./G.H.

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827 MAPLEDALE ROAD, ORANGE, CT 06477



CONSULTING ENGINEERS (CIVIL, HYDRAULICS, SANITARY)

827 MAPLEDALE ROAD, ORANGE, CT 06477 TEL: (203) 795-6562

Job_	BLUE HILLS	DAM
Sheet	Number D-4	
Date	12.22- 1980	
By_	R.S./G H	

# SURCHARGE STORAGES WATER SURFACE AREAS

RESERVOIR WATER SURFACE ELEVATION	HFIGHT ABOVE EMERGENCY SPILLWAY CREST (FT)	WATER SURFACE AREA (ACRES)	SURCHARGE STORAGE CAPACITY (AC-FT)
110.0	0.0	175.0	0,0
110.5	O· 5	187.0	90.0
111-0	1.0	200.0	195.0
111.5	1.5	215.0	300.0
112.0	2.0	230.0	400.0
112.5	2.5	2450	5 <i>00.0</i>
(13-0	3.0	260.0	600.0
113.5	3.5	275-0	750.0
114-0	4.0	290.0	900.0

**CONSULTING ENGINEERS** (CIVIL, HYDRAULICS, SANITARY) JOB BLUE HILL DAM Sheet Number D - 5
Date 17.23-1960 R.S./G.1+

JVORY

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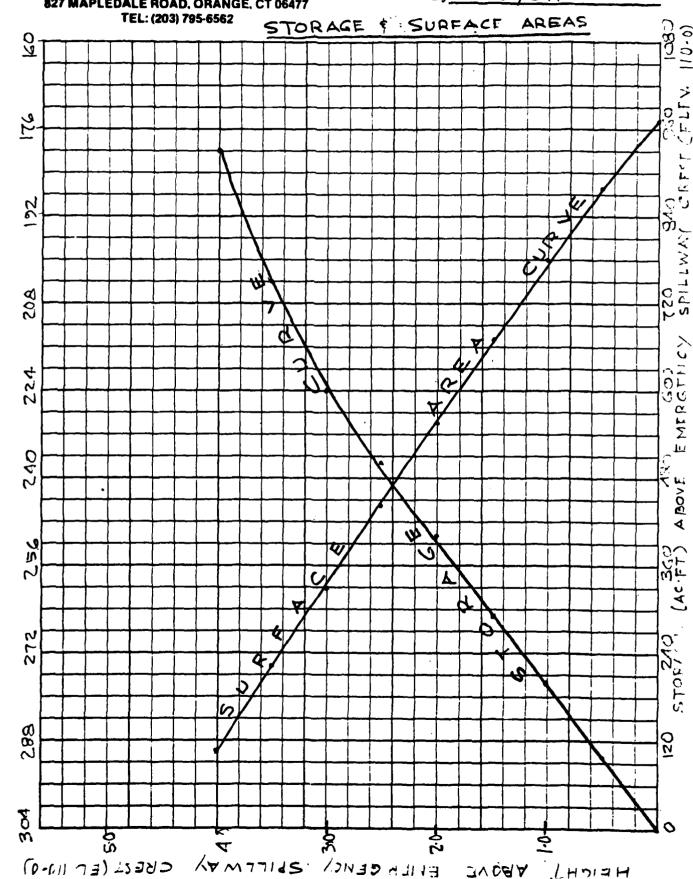
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CONSULTING ENGINEERS (CIVIL, HYDRAULICS, SANITARY)

827 MAPLEDALE ROAD, ORANGE, CT 06477 TEL: (203) 795-6562

AND

Job BLUE HILLS DAM
Sheet Number D-6
Date 12-23-1980
By R-S/GH

#### INFLOW FLOOD HYDROGRAPH

TEST FLOOD = 1,800 CFS

DRAINAGE AREA = 1.90 SQ. MILES

AS PER 'HYDROLOGY, SECTION 4, S.C.S. NATIONAL
ENGINEERING HANDBOOK:

$$q_p = \frac{484 \cdot A \cdot Q}{T_p}$$

$$T_b = 2.67 T_p$$

WHERE The TIME BASE OF HYDROGRAPH IN HOURS

TP = TIME IN HOURS FROM START OF RISE OF HYDROGRAPH TO ATTAINMENT OF PEAK.

PP = PEAK RATE OF RUNOFF IN CES

A = DRAINAGE AREA IN SQ. MILES

Q= TOTAL RUNOFF IN INCHES

SUBSTITUTING THE KNOWN VALUES OF A Q AND V;

$$1,800 = \frac{484 \times 1.90 \times 19}{T_{P}}$$

FROM WHICH Tp = 9.7 HOURS

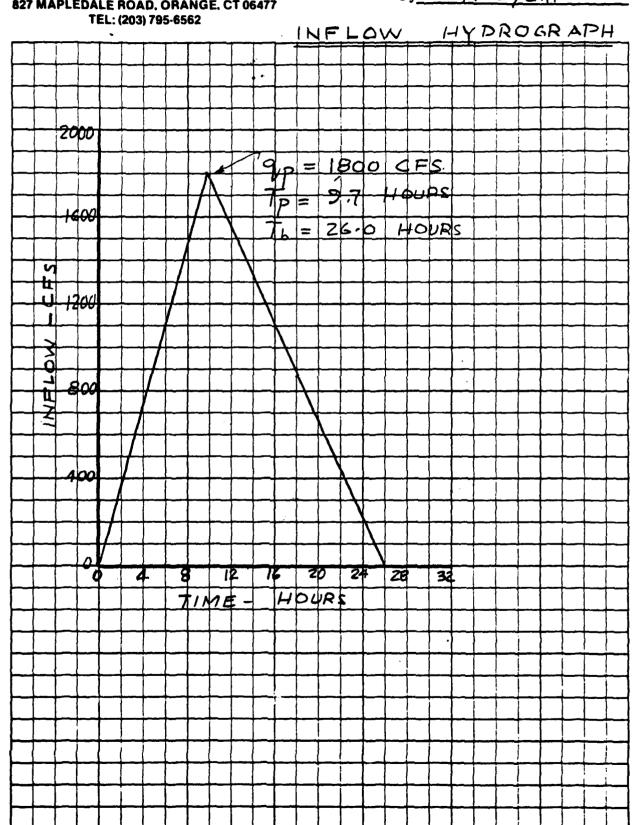
THE TRIANGULAR HYDROGRAPH HAS BEEN DRAWN ACCORDINGLY ON THE NEXT PAGE.

**CONSULTING ENGINEERS** (CIVIL, HYDRAULICS, SANITARY)

Job_	BLUE	HILL	DAM
	Number 7		
Date			
Ву	R	G.H.	

827 MAPLEDALE ROAD, ORANGE, CT 06477

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**CONSULTING ENGINEERS** (CIVIL, HYDRAULICS, SANITARY)

827 MAPLEDALE ROAD, ORANGE, CT 06477

Job BLUF HILL DAM

Sheet Number D - 2

Date 17. 23. 1980

By R.S./GH.

A CONTRACTOR OF THE PROPERTY OF THE PARTY OF

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RESERVOIC ELEVATION END OF AT.		110.02	10 · 02	110.09		110 22	110.22	10 42	110.39	110.60		500	110.83	40 ==	11105	\$2.11	111.20	11.46		111.65		22 111	111.74	641	72:111	5	ET111	10	
TOTAL STORAGE AC-FT.		0	3.9	17.9		93.8	43.4	6.62	6.87	121.1		6.0	0.87/	+60	2.012	2:152	252-9	292.7		7.628		8.4.3	348.5	583	352.3		24.6	8:83	1 0 1 2
STURAGE AS AS		4.0	3.9	13.9		0 %2	9.52	36	35.5	42-2		9.64	6.44	624	44.5	40,4	42.4	39.83		36.9		1	18.9	90	3.8	7:9	2.5-	8	0.0
AVERANE OUTFLOW FOR AT.		3.0	3.9	6.6		15.2	13.1	8:21	18.7	4.72		c. 66	40-2	28	24.0	8 62		9:0		0 01		0.63	8-62/	7:18:	7.621	30.6	130.0	126.8	125.0
DVITEDW RATE CFS. END AVG		4	94 47	130 112			184 151	243 213	272 272	628 766		256 474	572 482	855 698	772 672	1036 304	994 883	6601 5021		435 1320		1540 1548	535 (485	6251 523	573 1554	1351 025	547 1510	497 1522	1472 1510
TRIAL RESEDVOIR ELEVATION AT END OF		10 011	20.01	01:01			22.011	36 95	110.40	110,60		110.80	≥ 28.01		111.05	# 30 ##		111. 46 113		11.65		23	111. 73	98		54 1	111:74		]
AVERAGE INFLOW AC.FT.		8.2		23.52		38.7		5.4.2		9.69		1.58		5.001		116.0		138.4		146.9		142.7		133.4		(24 -3		0-511	
AVENAGE IN FLOW RATE SEC FT		93		827		464		059		835		102-1		9021		1392		1577		£921		1712		1991		1491		1380	
E ∆T HRS						_				1																			
TIME	0				2		3		4		2		9		_		8		6		10				12		3		

### CONSULTING ENGINEERS (CIVIL, HYDRAULICS, SANITARY)

827 MAPLEDALE ROAD, ORANGE, CT 06477 TEL: (203) 795-6562 Job BLUF HILL DAM
Sheet Number D - 9
Date 12. 22. 198.

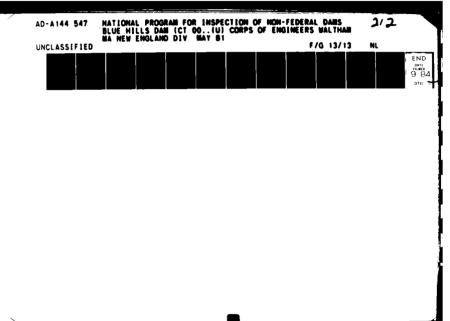
By R.S./G.H.

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CONSULTING ENGINEERS
(CIVIL, HYDRAULICS, SANITARY)

Job BLUE HILLS DAI
Sheet Number D - 10
Date
By R.S./GH

827 MAPLEDALE ROAD, ORANGE, CT 06477 TEL: (203) 795-6562 INFLOW & OUTFLOW HYDROGRAPHS INFLOW HYDROGRAPH (PEAK RATE = 1800 CFS) Li' OUTFLOW HYDROGRAPH PEAK RATE = 1575 CFS <del>836</del>4 S 20, 24 **TIME-**HOURS





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS - 1963 - A

CONSULTING ENGINEERS (CIVIL, HYDRAULICS, SANITARY)

827 MAPLEDALE ROAD, ORANGE, CT 06477 TEL: (203) 795-6562

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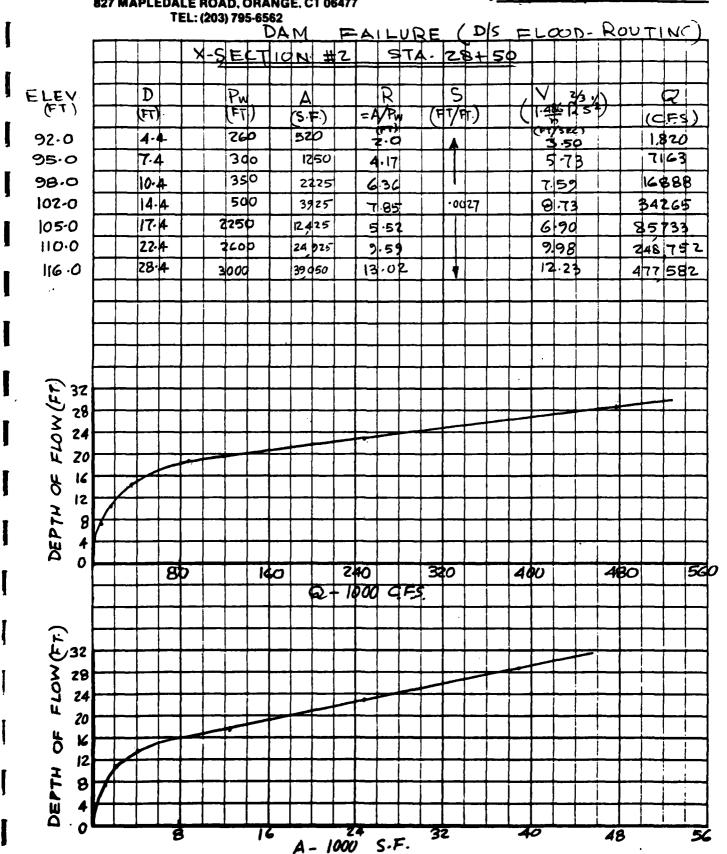
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By R.S./GH

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**CONSULTING ENGINEERS** (CIVIL, HYDRAULICS, SANITARY) JOB BLUE HILLS KESFRVOIR Sheet Number D- 15 DAM. 1981 1.22-**∙S** .

**827 MAPLEDALE ROAD, ORANGE, CT 06477** 



CONSULTING ENGINEERS (CIVIL, HYDRAULICS, SANITARY)

Job B	LUE	HILLS	REST	RVOIR
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827 MAPLEDALE ROAD, ORANGE, CT 06477

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ELEV D PW A R S V24 V

### CONSULTING ENGINEERS (CIVIL, HYDRAULICS, SANITARY)

827 MAPLEDALE ROAD, ORANGE, CT 06477 TEL: (203) 795-6562 Job BLUE HILLS RESERVOIR
DAN

Sheet Number D-17

Date 3.7.1981

By R.S./G.H

DAM FAILURE FLOOD ROUTING
X- SECTION #1 STA. 1840

FOR  $Q_{P_1} = 243000$  CFS.  $H_1 = 18.2'$  AND  $A_1 = 27860$  SF

REACH LENGTH = 1800' STORAGE = 27860 x 1800/43560 = 1150 AC.FT. ASSUME STORAGE = 800 AC.FT.

 $QP_2 = QP_1 \left(1 - \frac{800}{1050}\right) = 243,000 \times 0.74 = 58300 CFS$   $H_2 = 14.1'$ AND  $A_2 = 9600 \text{ SF}$ STORAGE =  $9600 \times 1800/43560 = 397 \text{ AC.FT}$ 

STORAGE = 9600 x 1800/43560 = 397 AC.FT AVG. STORAGE = 1/2 (397+800) = 600 AC.FT

 $Q_{P_3} = Q_{P_1}(1 - \frac{600}{1050}) = 243,000 \times 0.43 = 104,500 CFS.$ 

H3 = 16.0' AND A3 = 15100 SF.

STORAGE = 15100 x 1800/43560 = 624 AC FT AVG. STORAGE = 1/2 (624+600) = 612 AC FT

9p4 = 9p. (1-612) = 243000 × 0.42 = 102,000 CFS

H4 = 16.0' ROUTED FLOW= 102,000

POST- FAILURE FLOUD ELEV. = 90.3 + 16.0 = 106.3 (SAY 106.0)

PRE-FAILURE FLOW = 1575 CFS

FLOW DEPTH = 4.5

AND FLOUD ELEV. = 90.3+4.5

= 94.8 (SAY 95.0)

RISE IN FLOOD STARE = 106.0 - 95.0 = 11.0

NUMBER OF HOUSES FLOODED!

BEFORE FAILURE = 0

AFTER FAILURE = 10

CONSULTING ENGINEERS (CIVIL, HYDRAULICS, SANITARY)

Job BLUE HILLS RESERVOIRM Sheet Number D-18 Date 3.7.1981 By R.S./G.H

827 MAPLEDALE ROAD, ORANGE, CT 06477 TEL: (203) 795-6562

DAM FAILURE FLOOD ROUTING
X- SECTION #2 STA 28+50

FOR Op = 102,000 CFS, H1 = 17.9' AND A1 = 13,675

REACH LENGTH = 1050' STORAGE = 13675 ×1050/43560 = 330 AC.FT.

 $Q_{p2} = Q_{p1} \left( 1 - \frac{330}{1050} \right) = 102,000 \times 0.69 = 70400 \text{ CFS}$   $H_{2} = 16.5$  AND  $A_{2} = 9875$  S.F.

STORAGE = 9875 × 1050/43560 = 238 AC FT.

AVG. STORAGE = 1/2 (238 + 330) = 284 AC.FT.

 $Q_{P5} = Q_{P1} \left( 1 - \frac{284}{1050} \right) = 102000 \times 0.73 = 74,500 CFS$   $H_3 = 16.75'$ 

ROUTED FLOW = 75,000 CFS ±

POST - FAILURE FLOOD ELEV. = 87.6 + 16.75 = 104.35 SAY 104.5

PRE-FAILURE FLOW = 1575 CFS

WATER - DEPTH = 4.3

AND FLOOD ELEV. = 87.6 + 4.3

= 89.9 SAY 90.0

PUSE IN FLOOD STAGE 104.5- 50.0

NUMBER OF HOUSES & BUILDINGS FLOODED:

BEFORE FAILURE = 0

AFTER FAILURE = 31 +

CONSULTING ENGINEERS (CIVIL, HYDRAULICS, SANITARY)

827 MAPLEDALE ROAD, ORANGE, CT 06477 TEL: (203) 795-6562

JOB_BLUE	HILLS RESE	RVOR
Sheet Number	D-19	
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By R.S.	G. H.	

## . DAM FAILURE FLOOD ROUTING X- SECTION #3 STA . 35+0

FOR GP = 75000 CFS. H = 17.2 AND A = 12400 SF

REACH LENGTH = 650

STORAGE = 650 x 12400/43560 = 185 . O AC. FT.

 $Q_{Pz} = Q_{P1} \left(1 - \frac{185}{1050}\right) = 75000 \times 0.82 = 61500 CFS$  Hz = 16.3' AND Az = 10700 SF

STURAGE = 650x 10700/43500 = 160 AC. FT.

AVG. STORAGE = /2 (160 + 185) = 172.5 AC. FT.

 $Qp_3 = Qp_1 \left(1 - \frac{172.5}{1050}\right) = 75000 \times 0.84 = 63000 CFS$ 

H3= 16.4'

ROUTED FLOW = 63000 CFS

POST- FAILURE FLOOD ELEV = 86.0 + 16.4 = 102.4 SAY 102.5

PRE-FAILURE FLOW = 1575 CFS.

WATER - DEPTH = 5.0

AND FLOOD ELEV. = 86+5 = 91.0

RISE IN FLOOD STAGE = 102.5-91.0

NUMBER OF HOUSES AND BUILDING FLOODED:

BEFORE FAILURE = 0
AFTER FAILURE = 47 (+)

#### APPENDIX E

INFORMATION AS CONTAINED IN
THE NATIONAL INVENTORY OF DAMS

PRV/FED SCS A VER/DATE DAY MO YR 135 6881 18600 FED R POPULATION MAINTENANCE Z 4150.3 7242.8 FROM DAM (ML.) z LATITUDE LONGITUDE QUORTH) (WEST) MASKEL CONSTRUCTION ٥ AUTHORITY FOR INSPECTION CONSTRUCTION BY (3) HYPRAU MADUNCING CAPACITIES
HEPUT AGREMUM. ARRAMAT. DIST NED NONE NAME OF IMPOUNDMENT • INVENTORY OF DAMS IN THE UNITED STATES NEAREST DOWNSTREAM CITY-TOWN-VILLAGE PL92-367 2200 OPERATION 3 BLUE HILLS BLOOMF 12LD 20 Z MSPECTION DATE REGULATORY AGENCY WORAU-15DFCAD 24 ENGINEERING BY MAME Θ REMARKS REMARKS ◉ • 2 USOA BCS BLUE HILLS DAR CONSTRUCTION 137600 (CV) **③** PURPOSES RIVER OR STREAM アロア氏 1554 TH-BEAMANS SHOOK POPULAR NAME INSPECTION BY 4 0.0€A 1.0€ STATE KLENTITY LIVESON, STATE COLMIY COME GOMETY COME EXAM COMPLETED 1001 • SPILLWAY Θ 012 (1 OWNER 0 DESIGN 11 TYPE OF DAM Θ 5 GOI-DAI-II ないこと 490 VED CT 005 F., 10 0 EGON BASIN € **511**€ ACO. ◉ Ξ ž Θ  $\Theta$ 

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